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Assessment of the cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps in October 2005

Évaluation du stock de morue (*Gadus morhua*) de la sous-division 3Ps de l'OPANO en octobre 2005

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ABSTRACT

This document summarizes scientific information used to determine the status of the cod stock in NAFO Subdivision 3Ps off the south coast of Newfoundland. The current assessment provides estimates of the abundance of fish on 1 April 2005. Numbers-at-age are projected to 1 April 2006 by accounting for recorded catch up to the end of September 2005 and assumed catch for the remainder of the season to 31 March 2006. Principal sources of information available for this assessment were: reported landings from commercial fisheries (1959-March 2005), oceanographic data, a time series (1973-2005) of abundance and biomass indices from Canadian winter/spring research vessel (RV) bottom-trawl surveys, an industry offshore bottom-trawl survey (1997-2004), inshore sentinel surveys (1995-2004), science logbooks from vessels <35ft (1997-2004), industry logbooks for larger (>35 ft) vessels (1998-2004), and tagging studies (1997 onwards). The fishery was still in progress at the time of the assessment and complete information on catch rates and age compositions from the 15,000 t TAC from 1 April 2005 – 31 March 2006 was not available. Several sequential population analyses (SPA) were carried out using reported commercial catches, calibrated with various indices. Spawner biomass estimates for 1 April 2005 from the various SPA formulations considered covered a wide range and as in previous assessments, no single SPA formulation was considered to best represent absolute population size. Catches of cod in the 2004 GEAC survey and the 2005 DFO RV survey, particularly for the 1997 and 1998 year classes, were much lower than the preceding years. Also, sentinel line-trawl catches of the 1997 and 1998 year classes were not markedly different from those of other recent cohorts at the same age. These findings had a considerable effect on the stock size estimates for the recent portion of the time period and stock size estimates for the past 4-6 years were revised downward. The age composition of the spawner biomass in 2002-2004 comprised a high proportion of females that are mature at young ages. The spawner biomass still has many older females that are thought to be more effective at producing eggs, but the stock has produced only two strong year classes (1997-1998) in the period 1990-2002. Several of the most recent year classes (1999-2002) are estimated to be weak and these will feed into the fishery in the coming years. Medium term deterministic projections were conducted to provide managers with general insights into possible stock trends over the next three years. At fixed annual catch options ranging from 7,500 to 15,000 t projections indicated that spawner biomass would decline by 1 April 2008, but still remain well above the recommended biological limit reference point (B_{rec}). At a catch option of 5,000 t both formulations indicated a small increase (5-8%) in spawner biomass by 1 April 2008.

RÉSUMÉ

Dans ce document, nous résumons les données scientifiques utilisées pour déterminer l'état du stock de morue dans la sous-division 3Ps de l'OPANO, située au sud de Terre-Neuve. L'évaluation fournit une estimation révisée de l'abondance de la morue au 1^{er} avril 2005. Nous faisons une projection des effectifs par âge au 1^{er} avril 2006 en tenant compte des prises déclarées jusqu'à la fin de septembre 2005 et des prises présumées pour le reste de la saison, soit jusqu'au 31 mars 2006. Voici les données utilisées pour l'évaluation : débarquements déclarés des pêches commerciales (1959 – mars 2005), données océanographiques, une série chronologique (1973 – 2005) d'indices d'abondance et de biomasse obtenus par des relevés de navire de recherche (NR) canadien au chalut de fond, effectués à l'hiver et au printemps, ainsi que des données de relevés au chalut de fond effectués en haute mer par l'industrie (1997-2004), de relevés par pêche sentinelle dans les eaux côtières (1995 – 2004), des journaux de bord des bateaux < 35 pi de longueur (1997 – 2004), des journaux de bord des bateaux de l'industrie > 35 pi de longueur (1998 – 2004), et d'études d'étiquetage (1997 et suivantes). Au moment de l'évaluation, la pêche battait encore son plein, de sorte que les données complètes sur les taux de capture et la composition par âge pour le TAC de 15 000 t couvrant la période allant du 1^{er} avril 2005 au 31 mars 2006 n'étaient pas disponibles. Nous avons effectué plusieurs analyses séquentielles de population (ASP) reposant sur les prises commerciales déclarées, étalonnées par rapport à divers indices. Les estimations de la biomasse de reproducteurs au 1^{er} avril 2005 obtenues par les diverses variantes de l'ASP variaient considérablement et, comme pour les évaluations antérieures, aucune ASP n'a été considérée comme représentant le mieux la taille absolue de la population. Les prises de morue au cours du relevé du GEAC de 2004 et du NR du MPO de 2005, surtout en ce qui concerne les classes d'âge de 1997 et 1998, étaient beaucoup plus faibles qu'au cours des années précédentes. De plus, les prises de la pêche sentinelle à la palangre des classes d'âge de 1997 et 1998 ne différaient pas beaucoup de celles d'autres cohortes récentes au même âge. Ces résultats ont eu un effet considérable sur l'évaluation de la taille du stock pour la portion la plus récente de la période, de sorte que les estimations des 4 à 6 dernières années ont été révisées à la baisse. La composition selon l'âge de la biomasse génitrice en 2002-2004 englobait une forte proportion de femelles ayant atteint la maturité à un jeune âge. La biomasse génitrice comporte toujours de nombreuses femelles âgées que l'on considère plus fécondes, mais le stock a produit seulement deux fortes classes d'âge (1997-1998) au cours de la période de 1990 à 2002. Plusieurs des plus récentes (1999 à 2002) sont jugées faibles et viendront s'intégrer à la population exploitable dans les années qui viennent. Des projections déterministes à moyen terme ont été effectuées afin de fournir aux gestionnaires une idée générale des tendances possibles du stock au cours des trois prochaines années. Avec des niveaux d'exploitation potentiels annuels fixes oscillant entre 7 500 et 15 000 t, les projections montrent que la biomasse génitrice diminuerait au 1^{er} avril 2008, mais demeurerait bien au-dessus du point de référence biologique limite recommandé (B_{rec}). Avec un taux d'exploitation potentiel de 5 000 t, les deux formules indiqueraient une légère augmentation (5 à 8 %) de la biomasse de reproducteurs au 1^{er} avril 2008.

INTRODUCTION

This document gives an account of the information presented at the regional assessment of the Atlantic cod (*Gadus morhua*) stock in NAFO Subdiv. 3Ps located off the south coast of Newfoundland (Figs 1, 2). The assessment was conducted in St. John's, Newfoundland during 17-26 October 2005.

The history of the cod fishery in NAFO Subdivision 3Ps and results from other recent assessments of this stock are described in previous documents (Pinhorn 1969; Bishop et al. 1991, 1992, 1993, 1994, 1995; Shelton et al. 1996; Stansbury et al. 1998; Brattey et al. 1999a, b, 2000, 2001a, 2002a, 2003, 2004).

The directed cod fishery on this stock was reopened in May 1997 with a total allowable catch (TAC) set at 10,000 t. following a moratorium initiated in August 1993. The TAC was subsequently increased to 20,000 t in 1998 and further to 30,000 t in 1999. The TAC was subsequently reduced to 20,000 t in 2000, and for the past five management years (ending 31 March 2006) has been set at 15,000 t

The present assessment incorporates various sources of information on 3Ps cod, including the April 2005 DFO research vessel bottom-trawl survey data. The 2005/06 commercial fishery was still in progress at the time of the assessment meeting (October 2005). Detailed information on catch-at-age up to the end of March 2005 was available and preliminary catch information up to 1 October 2005 was also used. Additional sources of information included: oceanographic data (Colbourne and Murphy 2005), science logbooks for vessels <35ft (1997-2004), industry logbooks for vessels >35ft (1998-2004), an industry trawl survey on St. Pierre Bank from 1997-2004 (McClintock 2003, McClintock [in prep.]), inshore sentinel surveys from 1995-2004 (Maddock-Parsons and Stead 2005), and recaptures of tagged cod (received up to 10 September 2005) from tagging conducted during 1997-2003 (Brattey and Healey 2005).

In the current analyses it was assumed that the entire 15,000 t TAC would be taken in the fishing season from 1 April 2005 to 31 March 2006, as outlined in the management plan released by DFO prior to the start of the season. The current assessment provides revised estimates of the abundance of fish on 1 April 2005. Numbers at age are first projected to 1 April 2006 by accounting for recorded catch up to the end of September 2005 and assumed catch for the remainder of the fishery to 31 March 2006. In a second step, a deterministic medium term (3 yr) projection was conducted, where numbers were projected from 1 April 2006 to 31 March 2008 under a range of fixed annual TAC options.

1. Environmental overview

Oceanographic data from NAFO Division 3P during the spring of 2005 were examined and compared to the previous year and the long-term (1971-2000) average

(Colbourne and Murphy 2005). Temperature measurements on St. Pierre Bank show anomalous cold periods in the mid-1970s and from the mid-1980s to mid-1990s. Beginning in 1996 however, temperatures moderated, decreased again during the spring of 1997 and returned to more normal values during 1998. During 1999 and 2000 temperatures continued to increase, reaching the highest values observed since the late 1970s in some regions. During 2001-2003 however, temperatures cooled significantly to values observed during the mid-1990s with the average temperature during the spring of 2003 the coldest in about 13 years. Temperatures during both 2004 and 2005 warmed considerably over 2003 values to 1°C above normal in some areas. The areal extent of <0°C bottom water during 2003 increased to the highest in about 13 years but decreased during 2004 and 2005 to <10%, the lowest since 1988. The areal extent of bottom water with temperatures >3°C has remained relatively constant at about 50% of the 3P area during the past decade. On St. Pierre Bank bottom water with temperatures <0°C essentially disappeared during the warm years of 1999 and 2000, reappeared again during 2001 to 2003 and disappeared again during 2004 and 2005. In general, temperatures during the past two years increased significantly over values observed during 2001-2003.

2. Commercial catch

Catches (reported landings) from 3Ps for the period 1959 to 1 October 2005 are summarized by country and separately for fixed and mobile gear in Table 1 and Figs. 3a and 3b. Prior to the moratorium, Canadian landings for vessels <35 ft were estimated mainly from purchase slip records collected and interpreted by Statistics Division, Department of Fisheries and Oceans,. Shelton et al. (1996) emphasized that these data may be unreliable. Post-moratorium landings for vessels <35 ft have come mainly from a dock-side monitoring program initiated in 1997. Landings for vessels >35 ft come from logbooks. Non-Canadian landings (mainly France) are compiled from national catch statistics reported by individual countries to NAFO and there is generally a lag in the submission of final statistics; consequently, the most recent entries in Table 1 are designated as provisional.

The stock in the 3Ps management unit was heavily exploited in the 1960's and early 1970's by non-Canadian fleets, mainly from Spain and Portugal, with reported landings peaking at about 87,000 t in 1961 (Table 1, Fig. 3a). After extension of jurisdiction (1977), cod catches averaged between 30,000 t and 40,000 t until the mid-1980s when increased fishing effort by France led to increased total reported landings, reaching a high for the post-extension of jurisdiction period of about 59,000 t in 1987. Subsequently, reported catches declined gradually to 36,000 t in 1992. Catches exceeded the TAC throughout the 1980's and into the 1990's. The Canada-France boundary dispute led to fluctuations in the French catch during the late 1980's. A moratorium was imposed on all directed cod fishing in August 1993 after only 15,216 t had been landed, the majority being taken by the Canadian inshore fixed gear fishery (where inshore is typically defined as unit areas 3Psa, b, and c; Fig. 2). In this year access by French vessels to Canadian waters was restricted. Under the terms of the 1994 Canada-France agreement, France is now allocated 15.6% of the TAC, of which Canadian trawlers must fish 70%, with the remainder fished by small inshore fixed gear vessels based in St. Pierre and Miquelon.

Since 1997, most (~70%) of the TAC has been landed by Canadian inshore fixed gear fishermen, with most of the remaining catch taken by the mobile gear sector fishing the offshore, i.e. unit areas 3Psd, e, f, g, h (Table 1, Figs. 3a and 3b). This general pattern has been repeated throughout 1997-2004, although TAC's have ranged from 10,000 t to 30,000 t. During the 2004 calendar year, total reported landings were 14,414 t with the inshore fixed gear sector accounting for 9,450 t (65.6%) of the total (Table 1). In the 2005 calendar year to 1 October, the inshore fixed gear sector accounted for 5,343 t (61.5%) of the reported landings of 8,681t; the offshore mobile gear sector typically fishes in the late fall and early winter and this allocation had yet to be taken; inshore landings are also typically high in late fall (see below).

Line-trawl (=longline) catches dominated the fixed gear landings over the period 1977 to 1993, reaching a peak of over 20,000 t in 1981 and typically accounting for 40-50% of the annual total for fixed gear (Table 2, Fig. 4). In the post-moratorium period, line-trawls have accounted for 16 to 23% of the fixed gear landings. Gillnet landings increased steadily from about 2,300 t in 1978 to a peak of over 9,000 t in 1987, but declined thereafter until the moratorium. Gillnets have been responsible for the dominant portion of the inshore catch since the fishery reopened in 1997, with gillnet landings exceeding 10,000 t (i.e. 50% of the TAC) for the first time in 1998, and approaching 18,000 t in 1999. Gillnets have typically accounted for 70-80% of the fixed gear landings since 1998. Gillnets accounted for a lower percentage of the fixed gear landings in 2001 (60%), partly due to a management restriction in their use that was removed part way through the fishery following extensive complaints from industry. Gillnets are also being used extensively in the offshore areas in the post-moratorium period (see below). Trap catches have varied over the time period, but have not exceeded 8,000 t and have declined from 1,167 t to negligible amounts (< 120 t) from 1998 onwards. Hand-line catches were a small component of the inshore fixed gear fishery prior to the moratorium (about 10-20%) and accounted for <5% of landings during most of the post-moratorium period. However, hand-line catch for 2001 shows a substantial increase (to 17% of total fixed gear) compared with the 1998-2000 period and this may reflect the temporary restriction in use of gillnets described above.

Monthly landings during 2004 and up to 1 October 2005 are summarized for inshore (3Psa/b/c) and offshore (3Psd-h) and for each of the major gear types, in Table 3a. Inshore catches in 2004 have come mostly from gillnets with substantial gillnet landings (> 200 t) in most months except January-April. Line-trawls were fished inshore mostly during late summer and fall with highest monthly landings (>360 t) in October-November. Hand-line catches were taken mainly during summer and fall with a peak in August. In the offshore, otter trawl fishing by Canadian trawlers and vessels chartered by St. Pierre and Miquelon to fish the French allocation was concentrated mainly during the first and last quarters of the year. There was also a substantial offshore gillnet catch in 2004 with landings totaling over 2,241 t taken mostly during July-November. Line-trawls were fished in the offshore throughout the year but accounted for a small proportion of offshore landings, totaling <100 t each month. Overall, landings in 2004 were dominated by the directed gillnet fishery with the remaining catch taken by otter trawl, followed by hand-line and line-trawl, with negligible amounts taken by trap. Landings by gear type and season show no major changes in recent years.

The landings for the 2004 calendar year and the first nine months of 2005 are summarized by month and unit area in Table 3b. Inshore landings were low in April 2004 and came mostly from by-catch fisheries. Monthly landing trends in 3Psb and 3Psc show similar patterns, with peaks in June-July and November, whereas those in 3Psa were more variable through June-November. The distribution of landings among the three inshore unit areas has not changed significantly in recent years (see Brattey et al. 2004) with Placentia Bay accounting for most of the inshore catch.

In the offshore, monthly landings tended to be more variable among unit areas. Unit area 3Psh accounted for most of the offshore catch from winter otter trawl fisheries, but landings from 3Pse and 3Psf were also high (>1,300 t) in late summer and fall from vessels fishing gillnets. Preliminary landings for the 2005 calendar year for the offshore show similar spatial and temporal trends to those seen in 2004.

The distribution of post-moratorium catches among unit areas is illustrated in Fig. 5. The inshore (3Psa, 3Psb, and 3Psc) has consistently accounted for most of the reported landings. These have typically been highest in Placentia Bay (3Psc), ranging from 4,900 t to almost 11,650 t with typically 30-51% of the entire TAC coming from this unit area alone; however, this percentage has shown a slight decline recently, from 39% in 2001 to 30% in 2004. Landings from 3Psa and 3Psb have been fairly consistent at about 1,100-3,200 t and generally 7-12% and 9-18% of the TAC, respectively. Most of the offshore landings have come from 3Psh and 3Psf (Halibut Channel and the southeastern portion of St. Pierre Bank). Unit area 3Psg continues to have the lowest landings (<4% of the annual total each year since 1997).

The 1 April 2004 to 31 March 2005 conservation harvesting plan placed various seasonal and gear restrictions on how the 3Ps cod fishery could be pursued. Full details of these measures, which differ among gear sectors, are available from DFO Fisheries and Aquaculture Management (FAM) in St. John's.

2.1 Catch-at-age

Samples of length and age composition of catches were obtained from the inshore trap, gillnet, line-trawl and hand-line fisheries and the offshore otter trawl, gillnet, and line-trawl fisheries by port samplers and fishery observers. Sampling of the Canadian catch in 2004/2005 was intensive, with 7,900 otoliths collected for age determination and over 80,000 fish measured for length (Table 4A). The sampling was well distributed spatially and temporally across the gear sectors. Substantial landings in summer from inshore fixed gears (see Table 3) were sampled intensively, particularly line-trawl and gillnet. The smaller and more sporadic sampling of the offshore line-trawl catch reflects the small catch from that gear in 2004. Sampling during January-March 2005 has also been intensive with about 2,000 otoliths collected for age determination and 13,400 fish measured for length (Table 4b).

Sampling of the French gillnet and otter trawl landings was also conducted with over 200 otoliths collected and over 5,400 length measurements taken in 2004 (Table 4a), plus 4,100 length measurements and 383 otoliths in January-March 2005 (Table 4b).

The age composition and mean length-at-age of commercial catches were calculated as described in Gavaris and Gavaris (1983). The average weights were derived from a standard length-weight relationship where log(weight)=3.0879*log(length)-5.2106.

The catch at age for gill-netters and otter trawlers fishing the French allocation was provided by France. Catch-at-age for all gears combined based on sampling of Canadian and French vessels in 2004 and January to March 2005 is summarized in Tables 5a, 5b, 6 and Figs. 6a and 6b.

In the 2004 landings from all gears combined, a wide range of ages are represented (mostly 4-15 year olds) with ages 6 and 7 (1997 and 1998 year classes) accounting for 61% of the total catch by numbers (Fig 6a). The age composition of the 2004 catch is consistent with the catch from 2003, with the 1997 and 1998 year classes strongly represented in both years. The proportion of younger cod (ages 3-5) in the catch declined from 21% in 2003 to 15% in 2004. The percentage of older ages (>10 yr old) also declined from 12% in 2003 to 7% in 2004. The catch from the first three months of 2005 is taken mainly by mobile gear in the offshore and mostly comprised ages 7 and 8 year olds (1998 and 1997 year classes), although all ages from 3 up to 19 were present. Catch at age for the three main gear types for 2003 and 2004 is illustrated in Fig. 7a. The dominance of gillnet selectivity on ages 6-7 in both 2003 and 2004 is apparent. In comparison, line-trawls caught mostly younger fish of ages 4-6 in 2003 and ages 5-7 in 2004. In 2004, six and seven year olds were well represented in all gears including offshore mobile, suggesting that these two age classes (1997 and 1998) were widely distributed across the stock area and strongly represented in the population.

A time series of catch numbers-at-age (3-14) for the 3Ps cod fishery from 1959 to March 2005 is given in Table 6. As noted in recent assessments there are discrepancies in the sum of the product check for the 1959-1976 catch-at-age and attempts have been made to clarify these discrepancies by checking for missing catch and by adding plus group catch, but neither of these adequately explained the discrepancies. Further investigation is ongoing to check the fixed weights used for the 1959-1976 period and to check the sampling protocols to see if either contributed to the discrepancies. Until these discrepancies are resolved, catch at age prior to 1977 will not be used in SPA analyses.

The catch-at-age data that are available indicate that in the pre-moratorium period the landings were dominated by young fish, typically aged 4-6, whereas in the post moratorium period slightly older ages (i.e. 5-8) have been more common; this probably reflects the switch in dominant gears from line-trawl to gillnet. For the 2004 fishery, 6 and 7 year-old cod (1997-1998 year classes) dominated the final catch in terms of numbers. Note that the TAC, total landings, and gears employed in the fishery have been similar throughout the past five management years, yet the composition of the catch has shown some notable changes. The modal age in the catch has increased progressively over the past three years as the 1997 year class gets progressively older and moves through the peak ages selected by gillnets (typically ages 5-7). The 1998 year class follows the same pattern, but appears less strongly in the catch compared to the 1997 year class.

2.2 Weight-at-age

Mean weights-at-age in the 3Ps fishery (including landings from the commercial and food fisheries and the sentinel surveys) are given in Table 7a and Fig. 8a. Beginning of the year weights-at-age are given in Table 7b and Fig. 8b. The mean weights-at-age are derived from the sampling of catches taken by several gears in various locations at various times of the year; the weights at age may therefore vary with season and gear, and possibly by geographic area. The annual means by gear vary considerably; for example, mean weights-at-age in the 2002 3Ps fishery tended to be least in hand-line and greatest in offshore mobile gear (predominantly otter trawl) (Brattey et al. 2003), with the weight of the 1994 year-class at age 8 in the former being less than half the weight in the latter.

For young cod (ages 3-6), weights-at-age computed in recent years tend to be higher than those in the 1970s and early 1980s (Table 7a; Fig. 8a). The converse is true for older fish. Sample sizes for the oldest age groups (>10) have been low in recent years due to the relative scarcity of old fish in the catch. Interpretation of trends in weights-at-age computed from fishery data is difficult because of among-year variability in the proportion at age caught by gear, time of year and location.

The overall mean weights-at-age computed for recent years have some notable features. First, it was stated in Brattey et al. (2003) that apparent growth from 2001 to 2002 was unusually low for the 1989-1991 year-classes, and nil for the 1988 year-class. The weights-at-age for 2002 have been recomputed, and growth from 2001 to 2002 now appears greater for all year-classes. Second, as noted by Brattey et al. (2003), weight-at-age appears to depend to some extent on year-class. For example, the 1989 and 1993 year-classes appear to be relatively heavy at age 9, whereas the 1991 and 1992 year-classes appear relatively light. For this reason, it is difficult to state in a few words how growth in recent years compares to growth in the past.

The apparent variability in growth of year-classes lead to the decision, during the 2002 assessment, to obtain projected weights-at-age for 2002 by projecting along each year-class, rather than by using an average of the weights-at-age in the previous *n* years. The projection to weight at age *a* was accomplished by starting with the weight at age *a*-1 in 2001, and assuming that each cohort would grow at an instantaneous rate equal to the average of the instantaneous growth rates attained by the previous 4 cohorts over the age interval from age *a*-1 to age *a*.

As illustrated by Brattey et al. (2003), the process of projecting weights-at-age along cohorts was more successful in projecting the pattern in weight-at-age in 2002 than the process of projecting with average weights-at-age in the previous 3 years. (It was also noted that the process of projecting along cohorts tended to overestimate the observed weights in 2002, particularly at ages 10 and older. This difference has probably been reduced if one compares the projected weights for 2002 with the recomputed observed weights for 2002.)

The method of projecting along cohorts was also used in 2003 to project mid-year weights-at-age for 2004. With a continuing interest in projecting for 3 years, and an interest in projecting for longer terms for purposes other than those directly related to the assessment, the method of projecting along cohorts was again explored. Projection of weight-at-age *a* in mid-2004 was conducted using the weight already attained by age *a*-1 in 2003 and assuming that the year-class would grow at a rate equal to the average of the instantaneous growth rates experienced by the previous 6 year-classes over the age interval from age *a*-1 to age *a*. The process was extended forward until cohorts in the 2003 weight-at-age vector reached age 14. Cohorts not in the 2003 weight-at-age vectors were introduced at age 3 in 2004 and subsequent years at a weight computed as the geometric mean of the age 3 weights-at-age in 2001-2003.

This method of projecting along cohorts was rejected at the 2004 assessment meeting because the weight-at-age data were not statistically modeled, and because the weights-at-age computed for the 2001 and later cohorts appeared too high to some meeting participants. The previous method of projecting mean weights re-instituted at the 2004 assessment was continued in 2005, where weights-at-age *a* from 2005 onward were computed as the geometric mean of weights-at-age *a* in 2002-2004.

3. Sentinel survey

The sentinel survey has been conducted in 3Ps since 1995 and there are now ten complete years of catch and effort data (Maddock-Parsons and Stead 2005). During 2004, the sentinel survey continued to produce a time series of catch/effort data and biological information collected by trained fish harvesters at various inshore sites along the south coast of Newfoundland. In 2004, there were 14 active sites in 3Ps, using predominantly gillnets (5½" mesh) in unit area 3Psc (Placentia Bay) and line-trawls in 3Psb and 3Psa (Fortune Bay and west). One 3¼ " gillnet was also fished at each of 6 sites in Placentia Bay one day per week. Fishing effort was reduced in 2003 to an average of 6 weeks. Fishing times averaged 10 weeks in 2001 and 2002, 8 weeks in 2000 as opposed to 6 weeks in 1999 and 12 weeks from 1995-1998. Most fishing takes place in fall/early winter. Maddock-Parsons and Stead (2001, 2003a, b, 2004) have produced a time series of weekly average catch rates and annual relative length frequencies (number of fish at length divided by amount of gear). Catch rates for 5½" gillnets in 2004 were lower than those reported for comparable times in 2003, whereas line-trawl catch rates showed a general increase despite much weekly variability.

As in previous assessments, an attempt was made to produce an age dis-aggregated index of abundance for the ten completed years in the gillnet (5½" mesh) and line-trawl sectors of the program; there is insufficient data from the 3¼" gillnets to develop an index for this gear. Sentinel fishers typically fish a control and an experimental site; the location of the control site is fixed, whereas the location of the experimental site can change only within the local area.

4. Standardized sentinel catch rates

The catch from 3Ps was divided into cells defined by gear type (5½" mesh gillnet and line-trawl), area (unit areas 3Psa, 3Psb, and 3Psc), year (1995-2002) and quarter. Age-length keys were generated for each cell using fish sampled from both the fixed and experimental sites; however, only fish caught at the fixed sites were used to derive the catch rate indices. Length frequencies and age-length keys were combined within cells. The numbers of fish at length are assigned an age proportional to the number at age for that particular cell length combination. Fish that were not assigned an age because of lack of information within the initial cell were assigned an age by aggregating cells until the data allowed an age to be assigned. For example, if there are no sample data in a quarter then quarters are combined to half-year, half-years are combined to year; if an age still cannot be assigned, and then areas are combined for the year.

Catch-at-age and catch per unit effort (CPUE) data were standardized using a generalised linear model to remove site and seasonal effects. For gillnets, only sets at fixed sites during July to November with a soak time between 12 and 32 hours were used in the analysis. For line-trawl, sets at fixed sites during August to November with a soak time less than or equal to 12 hours where used in the analysis. Zero catches were generated for ages not observed in a set. Prior to modeling, data are aggregated within a gear-division-site-month-year-age cell. Sets with effort and no catch are valid entries in the model. Note that catch rates from the sentinel fishery are expressed in terms of numbers of fish, rather than catch weight as was used in the analyses of logbook data. This has important implications when comparing trends in these indices.

A generalised linear model (McCullagh and Nelder 1989) was applied to the sentinel catch and effort data for each gear type. The response distribution was specified as Poisson and the link function was chosen to be log. That is, the Poisson mean parameter μ_i is related to the linear predictor by

$$\log(\mu_i) = X_i^T \beta$$

where X_i^T is a vector of explanatory factors for catch observation *i* (i.e. month, site, age and year) and β is a vector of coefficients to be estimated from the data.

Thus, catch is assumed to have a Poisson probability distribution with the mean related to the factors month nested within site and age nested within year by

$$\log(\mu_i) = \log(E_i) + month_{i(j)}\beta_j\left(site_{i(k)}\beta_k\right) + age_{i(l)}\beta_l\left(year_{i(m)}\beta_m\right),$$

where log (E_i) is an offset parameter for fishing effort and j,k,l,m indicate the level for each of the four factors.

In the present assessment, the model adequately fitted data from gillnets and line-trawls.

Trends in standardized total (ages 3-10 combined) annual catch rates, expressed in terms of numbers of fish, are shown in Fig. 9a. For gillnets there is no trend over the period 1995-1997, but catch rates declined rapidly from 1997-1999 then remained stable but low from 1999 to 2004. For line-trawls, catch rates show a decline from 1995, but have been relatively stable from 1997 to 2004.

Two standardized annual catch rate-at-age indices were also produced in the present assessment, one for each gear type. All effects included in the model were significant. The standardized gillnet and line-trawl catch rate-at-age indices for 1995 to 2004 are given in Table 8 and Fig. 9b. For gillnets, the catches during 1995-1997 were dominated by the 1989 and 1990 year-classes and for the subsequent period the 1992 year-class is well represented, although catch rates for the latter do not appear to be as strong. During 2002-2004, the 1997 and 1998 year classes are not strongly represented in the sentinel gillnet catch. Gill-net catch rates for all ages in 2003 are among the lowest in the time series and there are no major changes in 2004. For line-trawls, catch rates were higher for the 1989 and 1990 year-classes during 1995 to 1996 followed by the weaker 1992 year-class. In the 2000-2002 sentinel line-trawl, catch rates improved for younger fish (3 and 4 year olds) compared to 1995-1999, but those for older fish continued to decline. The estimates for age 3 in 2003 and age 4 in 2004 (i.e. the 2000 cohort) are both the lowest in the series for those ages. The estimates for ages 5-7 in sentinel linetrawl in recent years have improved somewhat and reflect the appearance of the 1997 and 1998 year classes; the 1999 year class also appears reasonably strong at ages 3-5 in sentinel line-trawl but not in sentinel gillnet, or in other indices.

As described in recent 3Ps cod assessments, interpretation of the sentinel catch rate indices is difficult. Sentinel fisheries were free from competitive influences during 1995-1996 as the commercial fishery was closed. However, commercial fisheries may have had some disruptive influence on the execution of the sentinel fishery during 1997-2004, particularly in Placentia Bay. The concentration of fishing effort in Placentia Bay, primarily with gillnets, may have had a negative influence on the sentinel gill-net catch rates. Competition with commercial fishers for fishing sites, local depletion, inter-annual changes in the availability of fish to inshore, and shifts in the timing of sentinel fishing to accommodate periods of commercial fishing could all influence mean catch rates between years. The extent to which such effects influence catch rates are not fully understood. Nonetheless, the declines in sentinel gillnet catch rates when the fishery re-opened and continued low gillnet catch rate are interpreted as signs of concern. Furthermore, the gillnets do not track the 1997 and 1998 cohorts which are evident in other indices of the 3Ps cod stock. The decline in sentinel gill net catch rates after the fishery reopened in 1997 are consistent with the inshore catch rate data from science log-books and the high estimates of exploitation from tagging in Placentia Bay. In contrast, the line-trawl catch rates, which mainly incorporate data from areas west of the Burin Peninsula, show less of a decline and rates have increased for younger fish in recent years due to the appearance of the 1997 and 1998 year classes. The trends in the sentinel line-trawl data are also reasonably consistent with those seen in the line-trawl data from science log-books (see below). The cohort signals in the sentinel line-trawl are also reasonably consistent with the DFO RV survey index (section 7), the GEAC survey index (section 8), and the commercial catch-at-age.

5. Science logbooks (< 35 ft sector)

A new science logbook was introduced to record catch and effort data for vessels less than 35 ft in the re-opened fishery in 1997. The purpose of this logbook is for scientific stock assessments and not for quota monitoring or other controls on the fishery. Prior to the moratorium, the only data for vessels < 35 ft came from purchase slips, which provided limited information on catch and no information on effort. Since the moratorium, catch information comes from estimated weights and/or measured weights from the dockside monitoring program. Catch rates have the potential to provide a relative index of temporal and spatial patterns of fish density, which may relate to the overall biomass of the stock. There are currently data for about 85,000 records in the database, although only 5,900 are for 2004, the lowest since 1997. These data pertain to the inshore fishery, i.e. unit areas 3Psa, 3Psb, and 3Psc and for 2004 were comprised of 77% gillnet sets and 23% linetrawl sets. An initial screening of the data was conducted and observations were not used in the analysis if the amount of gear or location was not reported, more than 30 gillnets were used or <100 or >4,000 hooks were used on a linetrawl. As observed in previous assessments, preliminary examination of the logbook data indicated that soak time for gillnets is most commonly 24 hours with 48 hours the next most common time period. In comparison, line-trawls are typically in the water for a much shorter period of time – typically 2 hours with very few sets more than 12 hours. About 13% of the records were excluded using these criteria.

As in the previous assessment, effort was treated as simply the number of gillnets, or hooks for line-trawls (1000's), deployed in each set of the gear; soak times were not adjusted as the relationship between soak time, gear saturation and fish density is not known. Catch rates from science logbooks are expressed in terms of weight (whereas those from the sentinel fishery are expressed in terms of numbers); commercial catches are generally landed as head-on gutted and recorded in pounds; these were converted to kg by multiplying by 2.2026.

The frequency distribution of catches per set is skewed to the right for most gears (not shown). For gillnets, catches per set are typically 100-200 kg with a long tail on the distribution extending to about 2 t. The distribution of catches for line-trawls was similarly skewed.

The catch from 3Ps was divided into cells defined by gear type (gillnet and line-trawl), location (defined as lobster fishing areas 29-37 and illustrated in Fig. 10b in Brattey et al. 2002a), and year (1997-2004).

Initially, unstandardized CPUE results were computed and examined; in this preliminary analysis plots of median annual catch rate for gillnets and linetrawl were examined for each year-location. The 2004 gillnet catch rates were generally unchanged from 2003 except in Fortune Bay where the recent values were lower (Fig. 10). For linetrawl, most data comes from areas west of the Burin Peninsula and the results for Placentia Bay are based of fewer data and show more annual variability (Fig. 10). There were no consistent changes in median linetrawl catch rates in 2004 across sites; the value for area 32 in 2004 was the highest in the time series for that location, whereas the value for Hermitage (area 36) in 2004 was the lowest. In general, values for areas to the east tended to be higher for both gear types.

Prior to modeling, the data were aggregated by within each gear-year-month-location cell, and the aggregated data were weighted by its associated cell count. Catch per unit effort (CPUE) data were standardized to remove site (lobster area) and seasonal (month, year) effects. Note that sets with effort and no catch are valid entries in the model.

In the present assessment, the model adequately fitted data from gillnets and line-trawls and two standardized annual catch rate indices were produced, one for each gear type. All effects included in the model were significant. Preliminary analyses indicated that catch rates were generally higher for both line-trawl and gillnet in Placentia Bay compared to inshore areas further west.

From model results for gillnets, catch rates have shown a downward trend during 1998-2000 and have subsequently been low but stable (Fig. 10). The gill-net catch rates have declined from about 37 kg per net in 1997 to 17 kg per net in 2001, but subsequently remained fairly constant at 19-21 kg/net during 2002-2004. For line-trawls, catch rates declined from 303 kg/1000 hooks in 1997 to a minimum of 203 kg/1000 hooks during 2002, Values for 2003 and 2004 have been slightly higher at 241 and 243 kg/1000 hooks.

The observed trends in commercial catch rate indices for the inshore fishery are influenced by many factors. There have been substantial annual changes in the management plans in the post-moratorium period (Brattey et al. 2003). In addition, catch rates from mobile commercial fleets can be related more to changes in the degree of local aggregation of cod and can be a poor reflection of overall trends in stock abundance, particularly for stocks in decline. While this is likely to be a bigger problem with respect to otter-trawl derived catch rates, gillnets and line-trawls can also be deployed to target local aggregations. For inshore fisheries, catch rates can also be strongly influenced by annual variability in the extent and timing of inshore as well as long-shore cod migration patterns. Similarly, the changes in management regulations, particularly the switch from a competitive fishery to IQs can have a strong influence on catch rates that is unrelated to stock size. Consequently, inshore commercial catch rate data must be interpreted with caution. Where these data can be dis-aggregated into ages independently of the commercial catch at age data (as is the case with the sentinel survey) the information may be more easily interpreted in terms of stock size. Despite these issues, the initial declines in gillnet and line-trawl catch rates following the re-opening of the fishery in 1997 were cause for concern. The slight increase in modeled catch rates for line-trawl observed in 2003 appear to be reflecting the appearance of the 1997 and 1998 year classes in the inshore catch; however, catch rates have not improved further in 2004. Also, the modeled gillnet catch rates have shown no significant changes in recent years.

5.1 Industry logbooks (>35 ft sector)

Median annual catch rates by gear sector and unit area from log books of larger vessels (>35 ft sector) were also examined. The catch rate trends for these vessels fishing inshore areas (3Psa, b, c) generally agreed with those from the under 35 ft sector, but those for offshore areas mostly showed variable catch rates or declining trends. For similar reasons to those described above it remains difficult to interpret annual changes in catch rate data for the larger vessels, as management plans have changed considerably.

6. Tagging experiments

A project involving tagging of adult (> 45 cm) cod initiated in 1997 has continued since the previous (2004) assessment, but on a smaller scale since the fall of 2003. During December 2003 and 2004, cod were tagged in the offshore of 3Ps (3Psg/h) with the assistance of industry, but no new tagging of cod was conducted in the inshore of 3Ps during the spring of 2004 or 2005. Recoveries of tagged cod from the fishery are used to provide information on movement patterns and to estimate exploitation rates on cod tagged in different regions of the stock area (Brattey and Healey 2003, 2004, 2005). Since 1997, over 68,000 cod have been tagged and about 13,200 of these reported as recaptured, providing a substantial database of mark-recapture information. During 2004, >1,100 tags were returned from cod released in 3Ps.

6.1 Estimates of exploitation (harvest) rate

Brattey et al. (2001b, 2002a, 2002b) and Brattey and Healey (2003, 2004, 2005) used data from post-moratorium tagging experiments to estimate annual exploitation rates for cod tagged in various regions of 3Ps. The number of reported recaptures from individual cod tagging experiments gives minimum estimates of the exploitation rates on the aggregations of cod that were tagged. However, in practice, not all fish survive tagging, some tags are lost from fish particularly in the first year, and not all recaptures of tagged fish are reported. Tagged (and untagged) cod also suffer natural mortality due to factors such as predation and disease. Accounting for these losses leads to a reduction in the number of tagged (and untagged) animals available to the fishery. The design of the tagging study enabled estimates of tagging mortality, tag loss and reporting rates to be made and these were incorporated when estimating exploitation (Brattey and Healey 2003). Double tagging was used to estimate tag loss rates and a high-reward tagging study was used to estimate reporting rates (Cadigan and Brattey 2003; Cadigan and Brattey 2006); tagging mortality was estimated by various methods including retaining batches of tagged cod in submersible enclosures (Brattey and Cadigan 2004). Exploitation rates were estimated for cod tagged in a specific area at a specific time (i.e. individual tagging experiments), irrespective of where recaptures came from. In this analysis no attempt was made to estimate population sizes using tag returns and commercial catches, because typically some harvesting occurs in an area different from where fish were tagged. This makes it difficult to convert local catches to local population biomass.

Among cod tagged in Placentia Bay (3Psc), mean annual estimates of exploitation have declined from 34% in 1999 to 20% in 2004. For cod tagged in Fortune Bay (3Psb) mean annual estimates have been similar (10-11%) during 2000-2003, but declined slightly to 8.1% in 2004, with tag returns again indicating considerable movement of cod between Fortune Bay and Placentia Bay. For cod tagged in 3Psd (Burgeo Bank) the estimate for 2004 was 2.1%, comparable to the 2% estimated for 2003. Mean annual estimates of exploitation for cod tagged in offshore areas (3Psg/h) remain consistently low (2.2% for 2004 and ranging from 1.5-3.5% during 1998-2003).

As in the previous assessment, mean exploitation was estimated to be much lower among cod tagged offshore (3Psh) throughout 1998-2004 in spite of substantial offshore landings. These low offshore exploitation rates are consistent with a large offshore biomass in relation to the magnitude of recent offshore catches. However, the offshore estimates of exploitation are considered more uncertain because of localized offshore tagging coverage and localized distribution of fishing activity in the offshore. There is also greater uncertainty in the reporting rates of tags from the offshore, and in the survival of fish caught for tagging offshore in deep (>200 m) water.

Tagging coverage of the offshore was expanded in 2003 and again in 2004 to address some of these concerns and to investigate whether winter catches in the offshore portion of 3Ps included northern Gulf cod. A total of 1,000 cod were tagged and released in 3Psg/h during the December 2003 industry trawl survey and a further 1,750 tagged cod were released offshore in December 2004. To date, only 29 and 47 of the cod tagged offshore in December in 2003 and 2004, respectively, have been reported as recaptured. Results for 2004 were almost identical to those for cod tagged offshore in December in 2003, with recaptures taken either in the local offshore area (3Psh) or within Placentia Bay (3Psc). Neither of these tagging experiments has resulted in recaptures from the northern Gulf of St. Lawrence (3Pn4RS) stock area.

Annual movement patterns of 3Ps cod inferred from the post-moratorium tag returns have been consistent and suggest that the 3Ps stock comprises a complex group of sub-components that, at least as adults, do not mix thoroughly. The tagging suggests that there are coastal stock components that migrate extensively between Fortune Bay, Placentia Bay and in some years southern 3L, and that these do not mix extensively with cod in offshore regions of 3Ps. In addition, a portion of the offshore cod that over-winter in the southern edge of the Halibut Channel move onto the southeast corner of St. Pierre Bank during summer and fall, whereas others migrate seasonally inshore to Placentia Bay and the southern Avalon (3L) during summer. There is also mixing in western 3Ps with cod that migrate out of the neighbouring 3Pn4Rs stock area. The main consequences of the lack of thorough mixing within 3Ps is that local areas are prone to overexploitation and that it adds to the uncertainty of sequential population analyses of the stock as a whole.

7. Research vessel survey

Stratified-random surveys have been conducted in the offshore areas of Subdiv. 3Ps during the winter-spring period by Canada since 1972 and by France for the period 1978-92. The two surveys were similar with regard to the stratification scheme used, sampling methods and analysis, but differed in the type of fishing gear and the daily timing of trawls (daylight hours only for French surveys). Canadian surveys were conducted using the research vessels A. T. Cameron (1972-82), Alfred Needler (1983-84), and Wilfred Templeman (1985-2005). From the limited amount of comparable fishing data available, it has been concluded that the three vessels had similar fishing power and no adjustments were necessary to achieve comparable catchability factors, even though the A.T. Cameron was a side trawler. The French surveys were conducted using the research vessels Cyros (1978-91) and Thalassa (1992) and the results are summarized in Bishop et al. (1994).

The stratification scheme used in the DFO RV bottom-trawl survey in 3Ps is shown in Fig 11. Canadian surveys have covered strata in depth ranges to 300 ftm since 1980. Five new inshore strata were added to the survey from 1994 (779-783) and a further eight inshore strata were added from 1997 (293-300). For surveys from 1983 to 1995, the Engel 145 high-rise bottom trawl was used. The trawl catches for these years were converted to Campelen 1800 shrimp trawl-equivalent catches using a length-based conversion formulation derived from comparative fishing experiments (Warren 1997; Warren et al. 1997; Stansbury 1996, 1997).

The Canadian survey results (in Campelen-equivalent units, see below) are summarized by stratum (Fig. 11) in terms of numbers (abundance) and biomass in Tables 9 and 10, respectively, for the period 1983 to 2005. Strata for which no samples are available were filled in using a multiplicative model. Timing of the survey has varied considerably over the period. In 1983 and 1984 the mean date of sampling was in April, in 1985 to 1987 it was in March, and from 1988 to 1992 it was in February. Both a February and an April survey were carried out in 1993; subsequently, the survey has been carried out in April. The change to April was aimed at reducing the possibility that cod from the adjacent northern Gulf (3Pn4RS) stock would erroneously be counted as part of the 3Ps stock. A portion of the Northern Gulf cod stock may cross the stock boundary into the Burgeo Bank area (see Fig. 1) and mix with 3Ps cod in winter in some years, and migrating back into the Gulf some time during the following spring. Campana et al. (1998, 1999, 2000) has suggested that mixing may be substantial and recent tagging studies suggest that it may extend into April in some years (Brattey et al. 2001b, 2002b; Brattey and Healey 2003). However, the extent, timing, and duration of mixing are variable and at present there is no reliable method to assign survey catches to the appropriate stock on an annual basis. Examination of the age composition of cod caught in the western portion of 3Ps during surveys from 2001-2004 revealed age-classes characteristic of 3Ps cod, i.e. the 1997 and 1998 year classes have been strongly represented.

7.1 Abundance, biomass, and distribution

A time series of trawlable abundance and biomass estimates from random stratified RV surveys is given in Tables 9 and 10. Details of the catch estimates by stratum, timing of the surveys, number of sets fished, and vessel(s) used are also given. Stratum boundaries are shown in Fig. 11. The abundance and biomass index estimates for the 2004 survey were 45.8 million fish and 80,560 t, respectively. The corresponding values for the 2005 survey were 42.7 million fish and 46,059t. In the 2005 survey there were no major changes in the distribution of survey catches. The strata with the three largest catches in terms of biomass were 294 off the Burin Peninsula, 315 on Southern St. Pierre Bank, and 319 located in the Halibut Channel; these three strata accounted for 87.9% of the biomass index and 65.3% of the abundance index for the stock area.

Trends in the abundance index and biomass index from the RV survey of the index strata in 3Ps (depths less than or equal to 300 ftm, excluding the new inshore strata) are shown Fig. 12. The time series for both indices from 1983 to 1999 show considerable variability, with strong year effects in the data. Both abundance and biomass are low after 1991 with the exception of 1995, 1998, and 2001. The 1995 estimate is influenced by a single enormous catch contributing 87% of the biomass index and therefore has a very large standard deviation. The 1997 Canadian index was the lowest observed in the time series, which goes back to 1983, being less than half of the 1996 index. The size composition of fish in the 1997 RV survey suggested that this survey did not encounter aggregations of older fish, yet these fish were present in the 1996 survey and in subsequent commercial, sentinel, and survey catches. The minimum trawlable abundance index has declined from 88.2 million in 2001 to 42.7 million in 2005. The minimum trawlable biomass estimate for 2005 is lower than the 2004 estimate but the biomass index shows no clear trend in the post-moratorium period. In general, trends in the abundance and biomass indices depicted in Fig. 12 are difficult to discern due to high intra-annual variability. Excluding the 1995 and 1997 survey results would suggest the time series can be broadly divided into three periods – highest during 1983-1990, lowest during 1991-1997, and intermediate values during the most recent period 1998-2005.

The survey data are also expressed in terms of catch rates (i.e. mean numbers per tow) for the survey as a whole (Fig. 13) and for the eastern and western portions of the stock area separately (Fig. 14). The trend for the eastern portion of the stock area is similar to that for the abundance and biomass indices for the stock area as a whole. Catch rates for the eastern portion show considerable variability, with strong year effects, but are generally higher in the 1980's, and low after 1991, and intermediate in the late 1990's and early 2000's. The 1995 estimate is influenced by a single large catch taken at the southern end of Halibut Channel. The catch rates for the western (Burgeo) portion, which has been surveyed in April since 1993, are extremely variable, but are generally higher than those for the eastern region. The value for 1998 is extremely high due to several large catches on Burgeo Bank and vicinity that may have included fish from the neighbouring northern Gulf (3Pn4RS) cod stock. The trends in recent years (since 2001) have diverged between indices for the eastern and western portions, with the eastern region showing a decline and the western region showing a slight increase. The overall trend in the combined index is a slightly downward in recent years.

The spatial distribution of catches of cod during the 2005 survey was examined for all ages combined (Fig. 15) and separately for ages 1-8 (Figs. 16-17). Brattey et al. (2004) showed that during 1999-2004 cod were caught over a considerable portion of NAFO Div. 3P with the largest catches typically in the southern Halibut Channel area, on Burgeo Bank and vicinity, in the outer portion of Fortune Bay, and in 3Pn. During these years cod were consistently scarce in the deep water below the mouth of Placentia Bay and in the inner reaches of Hermitage Channel. Since 2000, catches of cod on the central portion of St. Pierre Bank have become progressively scarcer. In the 2003 and 2004 surveys, the distribution of cod was similar to that of the 2002 survey, with no large catches on St. Pierre Bank. In the 2005 survey, the distribution of survey catches shows no major changes, except that some larger catches were taken on the western flank of St. Pierre Bank. Larger catches were taken mainly on Burgeo Bank, the outer portions of Fortune Bay, northern St. Pierre Bank and Halibut Channel.

The age-disaggregated distribution of survey catches is shown in Figs. 16 and 17. There were no large catches of 1 and 2 yr old cod. Larger catches of 3, 4, and 5 yr olds were taken mainly on Burgeo Bank, Halibut Channel and the tip if the Burin Peninsula. The only large catches of older cod (> 5 yr old) were also taken off the tip of the Burin Peninsula and in Halibut Channel.

Colbourne and Murphy (2005) updated their previous analysis (Colbourne and Murphy 2004) of changes in the distribution of survey catches in relation to temperature and concluded the following: "The most evident trend in the numbers of cod caught per set during the multi-species surveys was the high number of zero catches in the <0°C water on St. Pierre Bank and regions to the east of the Bank, mainly from 1985 to 1998 but also from 2001 to 2003. During 1999 and 2000 larger catches became more wide spread over St. Pierre Bank as cold (<0°C) water disappeared from the area. In general, during most surveys the larger catches occurred in the warmer waters (2°-6°C) along the slopes and areas to the west of St. Pierre Bank. In 2004 there was no observed shift in the distribution of cod over St.

Pierre Bank and there were many low or zero catches in the warm deeper waters off the banks compared to most years. During the spring of 2005 however there was an increase in the number of non-zero catches on St. Pierre Bank and an apparent increase in the size of the catches in deeper waters with temperatures >2°C. Finally, variations in the estimated abundance and biomass of cod from the RV surveys in strata with water depths <92 m are significantly correlated with bottom temperatures for that depth range".

7.2 Age composition

Survey numbers at age are obtained by applying an age-length key to the numbers of fish at length in the samples. The current sampling instructions for Subdiv. 3Ps require that an attempt be made to obtain 2 otoliths per one cm length class from each of the following locations: Northwest St. Pierre Bank (strata 310-314, 705, 713), Burgeo Bank (strata 306-309, 714-716), Green Bank-Halibut Channel (strata 318-319, 325-326, 707-710), Placentia Bay (strata 779-783) and remaining area (strata 315-317, 320-324, 706, 711-712). This is done to spread the sampling over the survey area. The otoliths are then combined into a single age-length key and applied to the survey data. The resulting estimates of age-disaggregated mean numbers per tow are given in Table 11. It is in this form that the data are used in the calibration of sequential population analysis models. These data can be transformed into trawlable population at age by multiplying the mean numbers per tow at age by the number of trawlable units in the survey area. This is obtained by dividing the area of the survey by the number of trawlable units. For 3Ps, the survey area is 16,732 square nautical miles including only strata out to 300 ftms and excluding the relatively recent strata created in Placentia Bay. The swept area for a standard 15 min tow of the Campelen net is 0.00727 square nautical miles. Thus, the number of trawlable units in the 3Ps survey is $16{,}732 \div 0.00727 = 2.3 \times 10^6$.

The mean numbers per tow at age in the RV survey for the entire index is given in Table 11A. Cod up to 20 years old were not uncommon in survey catches during the 1980's, but the age composition became more contracted through the late 1980s and early 1990s. Survey catches over the post-moratorium period have consistently shown few survivors from year-classes prior to 1989. Recent surveys (2000-2004) indicate that the 1997 and 1998 year classes are stronger than those seen through the mid-1990s, given that their catch rates are much higher and they track through the time series quite consistently. These 1997 and 1998 year classes also appear strong in recent GEAC surveys, and to a lesser extent in recent sentinel line trawl (Table 8). However, in the 2005 survey index the 1997 and 1998 year classes are much weaker and have low abundance relative to recent catches of ages 7 and 8. The 1999 and 2000 year classes (ages 5 and 6) also appear relatively weak and are much less strong than those of 1997 and 1998 at the same age (i.e. age 5 and 6 during 2005, and age 4 and 3 during 2004). The 2001 and 2002 year classes appear stronger, but close inspection of the distribution of survey catches shows that these ages were much more strongly represented in the western portion of the stock area (see below). This indication of poorer incoming recruitment from the survey index is cause for concern as these year classes will enter the commercial catch in the next few years. Overall, the age composition of survey catches has expanded in recent years with ages up to 16 yrs represented; however, the age structure remains somewhat contracted relative to the mid-1980s with presently few fish older than age 15.

The age composition of the survey catches from the eastern and western portions of the stock area can be compared from 1993 onwards (Table 11B). Catches-at-age per tow have tended to be higher in the western portion of the stock area, with a notable year effect in 1998, when several age classes (3-9) appeared strongly in the survey catches; however, none of these year classes have subsequently appeared strongly in surveys in the western portion of 3Ps. A notable finding in the recent (2000-2004) survey catches from western (and eastern) 3Ps is the consistently strong representation of the 1997 and 1998 year classes; however, these year classes appear weak in the 2005 survey catches from western and eastern portions of the stock area. The 2001 and 2002 year classes appear stronger at ages 3 and 4 in the 2005 survey, but were not particularly well represented at younger ages and larger catches were localized in the western portion of the stock area; consequently, until more data become available it remains difficult to determine whether this result is simply a year effect or is indicative of stronger year classes. Another recent finding was the strong representation of the 1999 year class in western 3Ps survey catches up to 2004 but this result has not persisted in the 2005 survey index; this year class was also well represented in the sentinel line-trawl index which uses data mostly from inshore sites in western 3Ps. The 1999 year class has been relatively weak in the DFO RV index for eastern 3Ps and in the DFO RV index for the entire stock (i.e. non-split index). The 1999 year class has not appeared strongly in survey or commercial catches in the northern Gulf (3Pn4RS). Collectively, these results suggest it may be relatively strong only in the western portion of 3Ps. In general, the age composition of recent survey catches from eastern and western 3Ps have been consistent; the main differences are that the western region alone has shown a strong presence of the 1999 year class up to 2004 and large numbers of 3 and 4 yr olds (2001 and 2002 yr classes) in the 2005 survey.

7.3 Size-at-age (mean length and mean weight)

The sampling protocol for obtaining lengths-at-age (1972-2005) and weights-at-age (1978-2005) has varied over time (Lilly 1998), but has consistently involved stratified sampling by length. For this reason, calculation of mean lengths and weights included weighting observations by population abundance at length (Morgan and Hoenig 1997), where the abundance at length (3-cm size groups) was calculated by areal expansion of the stratified arithmetic mean catch at length per tow (Smith and Somerton 1981).

Mean lengths-at-age (Table 12; Fig. 18a) varied over time. A peak occurred in the mid-1970s for young ages (3-4) and progressively later to 1980 for older ages. This peak does not track individual year-classes particularly well but, in general, year-classes born in the 1970s experienced faster growth than those born in the 1980s (Lilly 1996; Chen and Mello 1999a). There was a decline in length-at-age from the early 1980s to the late 1980s or the early to mid-1990s, with the duration of the decline increasing with age (Fig. 18a, b). There has been an increase in length-at-age since the mid-1990s, but not to the levels seen in the early 1980s.

Year-to-year variability at older ages has been considerable (as much as 20 cm at age 10) during the past decade or so. There has not yet been a thorough analysis to determine if these differences were caused mainly by environmental factors (e.g. temperature or prey availability), cohort factors (e.g. cohort abundance or distribution) or any of the numerous additional possibilities, such as changes in maturation schedules (Chen and Mello 1999b) or size-selective fishing mortality. Variability associated with sampling or processing could also be important.

Much of the high variability in length-at-age at older ages (say 7-10) appears to be caused by cohort effects. For example, the 1989, 1990 and 1992 year-classes were relatively long at age, whereas the 1988, 1991 and particularly the 1987 year-classes were relatively short (Brattey et al. 2003). There has not yet been an investigation of the reasons for such cohort effects.

Another important contributor to variability in the estimates of size-at-age at older ages is the increase in range of sizes within a cohort as it ages, combined with a decrease in sample size at length, the latter being a simple consequence of declining abundance.

Selectivity characteristics of the research trawl are of concern for accurate estimation of size-at-age at younger ages, particularly ages 1 and 2. It may be assumed that estimation at younger ages has improved since the change to the Campelen trawl in 1996.

An exploration of the effects of environmental factors such as temperature has not been conducted because there appears to be negative growth at ages less than 10 for at least 2 cohorts during each of the intervals 1977-1978, 1980-1981, 1989-1990 and 1993-1994 (Lilly 1998). Such extreme year effects could result from the existence within 3Ps of groups of fish with different growth rates, coupled with annual variability in the proportion of the age sample taken from each of those groups. This possibility is discussed further by Lilly (1996), but has not yet been explored.

As expected, the patterns in mean weight-at-age (Table 13; Fig. 19a, b) appear to be very similar to those in length-at-age. The high year-to-year variability at older ages in recent years, noted above for length-at-age, is much more pronounced in weight-at-age, with weights-at-age in some years being more than twice that in others. The weight-at-age estimates may include more sampling variability than the length-at-age estimates in years prior to 1990 because they are based on much smaller sample sizes (Lilly 1998). The weight-at-age data also include variability associated with among-year and within-year variability in weight at length (condition).

7.4 Condition

The somatic condition and liver index of each fish were expressed using Fulton's condition factor $((W/L^3)*10^5)$, where W is gutted weight (kg) or liver weight (kg) and L is length (cm). Condition and liver index at age were calculated as described above for size-at-age.

Mean somatic (gutted) condition at age (Table 14; Fig. 20A) was variable from 1978 to 1986 and relatively constant from 1986 to 1992. It dropped suddenly in 1993, rose to an intermediate level in 1996-1998 and subsequently declined, although the most recent values have returned to an intermediate level. Condition at age could be influenced by changes in length-at-age (see above) combined with the tendency for condition calculated with Fulton's formula to increase with body length. For this reason, condition at length (Fig. 20B) might be more appropriate than condition at age as an indicator of changes in condition over time. In addition, much of the apparent annual variability in the survey data is related to the timing of the surveys (Lilly 1996). When mean condition in each of three length groups was plotted against the median date of sampling during the survey (Fig. 20C), there was a gradual decline in condition from the earliest median date (Feb. 7) to approximately late April, after which there was an increase. The time course of changes from late April onward is poorly defined because of the paucity of observations. Sampling of cod caught during sentinel surveys in the inshore in 1995 revealed a similar decline in condition during the winter and early spring, with a minimum in late April to early June (Lilly 1996).

Mean liver index at age (Table 15; Fig. 21A) had a pattern similar to that seen in somatic condition, except that the values in 1983 were more clearly at higher levels than during other years in the early 1980s and there was a more pronounced peak in the late 1980s and early 1990s. When the values for specific size groups (Fig. 21B) were plotted against the median date of sampling (Fig. 21C), there was a very pronounced decline in liver index during winter and early spring. A similar decline was evident in samples from the 1995 sentinel survey (Lilly 1996).

From the above, it is clear that the low levels of somatic condition and liver index in recent years (1993-2005) are mainly a consequence of sampling near the low point of the annual cycle and are not indicative of a large and persistent decline in well-being. Nevertheless, it is apparent that there was some annual variability within this recent time period. To explore this a little further, percentiles of gutted condition and liver index were calculated for all cod of a relatively wide size range (40-59 cm) sampled during the 1993-2005 period. There was considerable variability in gutted condition (for the period 1993-2003: median = 0.693; 90th percentile range = 0.597 – 0.792; n = 1814). The distributions did not vary much among years, but the medians in 1996, 1998, 2003 and 2005 were somewhat higher than in other years (Fig. 22). Percentiles for liver index were also highly variable (for the period 1993-2003: median = 0.0174; 90th percentile range = 0.0064 – 0.0376; n = 1825). Median liver index was highest in 1998, 2003 and 2005 and lowest in 1999 and 2001. Reasons for these small annual differences have not been investigated, but they are undoubtedly complex.

7.5 Maturity and spawning

The gonads of samples of cod collected during annual DFO winter/spring bottom-trawl surveys were visually inspected and assigned to the category "immature" or "mature" according to the criteria of Templeman et al. (1978). Mature fish were further classified as maturing, spawning, or spent (see Morgan and Brattey 1996). Visual inspection is not always totally accurate and there can be difficulties in classifying some stages. For example, mature fish that are skipping a spawning year (Rideout et al. 2005) may be erroneously classified as immature or vice-versa. Mature fish with a developing gonad may resorb the eggs and not spawn that year. Also, mature fish that have recently shed a batch of hydrated eggs may be classified as maturing when they are in fact spawning. The extent to which these errors influence the estimation of proportion mature and proportion at each stage of maturation has not been fully evaluated. Bolon and Schneider (1999) showed using histological methods that the visual method of classification was reasonably accurate, but tended to slightly underestimate the proportion of spawning fish and overestimate the proportion of maturing fish among cod sampled in Placentia Bay when spawning was taking place; however, this would not influence the estimation of the proportion mature/immature which is conducted mainly to estimate the spawning stock biomass. Morgan and Rideout (2005) estimated the frequency of skipped spawning in 3Ps cod and found that on average 84% of female cod in 3Ps were estimated to spawn each year with little variability in this estimate from year to year; this finding suggests that in most years failure to detect skipped spawning in mature fish would not have a major influence on estimation of spawning stock biomass of 3Ps cod.

In the assessments conducted since 2000, maturation of 3Ps cod has been estimated by cohort; prior to 2000 maturation was estimated by year. In addition, data extending back to 1954 have been included in the analyses of maturation. Annual estimates of age at 50% maturity (A_{50}) for females from the 3Ps cod stock, collected during annual winter/spring DFO RV surveys, were calculated as described by Morgan and Hoenig (1997). Trends in age at 50% maturity (A_{50}) are shown in Fig. 23A and only cohorts with a significant slope and intercept term are shown; parameter estimates (and SE's) for cohorts from 1954 to 2000 are given in Table 16. The estimated A_{50} was generally between 6.0 and 7.0 for cohorts from the mid-1950s to the early 1980s, but declined dramatically thereafter to 5.1 in the 1988 cohort (Table 16, Fig. 23A). Declining age at maturity has been observed in other cod stocks and may reflect genetic changes in the population that may be cause for concern (Trippel 1995; Heino et al. 2002; Olsen et al. 2004, 2005). Age at maturity by cohort remained low but fairly constant for the 1988 to 1994 cohorts; estimates for the 1995 and 1996 cohorts appeared to be increasing, but are followed by a further decline for the 1997 and 1998 cohorts with the latter having the lowest A_{50} in the time series at 4.6 yr. Similarly, estimates for the most recent cohorts (1999 and 2000) are more uncertain because only younger ages from these cohorts are available to estimate A_{50}. Males show a similar trend in A_{50} over time (data not shown), but tend to mature about one year earlier than females. Annual estimates of the proportion mature at age are shown in Table 17; these were obtained from the cohort model parameter estimates in Table 16. The estimates of proportion mature for ages 3-8 show a similar increasing trend (i.e. increasing proportions of mature fish at young ages) through the late 1970s and 1980s, particularly for ages 5, 6, and 7 (Fig. 23B). Also, the model estimates for the proportion mature at age 6 in the 1997 and 1998 cohorts are much higher than those of recent cohorts at the same age and this has a substantial effect on the recent estimates of spawner biomass for this stock. In addition, the age composition of the spawning biomass may have important consequences in terms of producing recruits. A spawning stock biomass that consists mainly of older fish, or a broad age range, may result in a longer time span of spawning (Hutchings and Myers 1993; Trippel and Morgan 1994). Older, larger fish also produce more viable eggs and larvae (Solemdal et al. 1995; Kjesbu et al. 1996; Trippel 1998). Several characteristics of the spawning stock biomass (SSB) of 3Ps cod (and other NF fish stocks) were explored for variability and for relationships with the residuals from Beverton-Holt stock-recruit models (Morgan et al. 2000). Weighted mean age of the SSB, proportion of first time spawners, and proportion female all showed substantial variability over time, but the results were not consistent among the stocks examined and were difficult to interpret.

The time series of maturities for 3Ps cod shows a long-term trend as well as considerable annual variability. To project the maturities for 3Ps cod forward to 2010, for each age group the average of the last three estimates for the same age group was used (Table 17). To fill in missing age groups in the early part of the time series the average of the first three estimates for the same age was used. These values were available for projections of mature spawner biomass in the evaluation of TAC options (see Section 8). There has been considerable debate at recent assessments about the best way to project maturities forward for 3Ps cod and other stocks. The present method can result in large changes in the estimates of proportion mature for incomplete cohorts, and hence considerable variability in the most recent estimates and projections of spawning stock biomass. For the most recent cohorts there are no data for older ages and model fits use data from younger ages. Alternative methods that also use information from older ages in adjacent cohorts are presently being explored to provide more reliable estimates of maturity for unfinished cohorts and for projections.

Maturities of adult female cod sampled in four sub-areas of NAFO subdivision 3Ps during winter/spring RV bottom-trawl surveys from 1983-2005 are shown in Fig. 24. Note that immature fish are excluded from this analysis. The areas are defined as Burgeo Bank / Hermitage Channel (Strata 306-310 and 714-716), Southern 3Ps / Halibut Channel (all areas south of 45°34.5' N), mid-3Ps which includes the remainder of the subdivision (excluding inshore strata 293-300 and 779-783), and inshore strata (293-300 and 779-783). The timing of the survey varied through the time series, with surveys predominantly in April during 1983-84, March during 1985-1987, February from 1988-1992, and April from 1993 to 2005. There were two surveys (February and April) in 1993; only the April one is shown here. The four sub-areas show a consistent pattern of maturity stages across most of the time series, with maturing fish dominating in most years. The switch in timing from February to

April clearly results in an increase in the proportions of spawning fish and a reduction or disappearance of fish that are spent from the previous year. When surveys were conducted in April, spawning and spent fish were found in each area; within any one year the proportion of spawning and spent fish tended to vary among sub-areas, but generally about 15-40% of the mature fish sampled were spawning or recently spent. The results from the 2005 survey show no dramatic changes from recent years. The results from the April 2003 sample from the Halibut Channel appear somewhat anomalous, with a high proportion of spent fish compared to other areas. The results also show that a substantial proportion (typically 20-40%) of the mature female cod sampled in the Burgeo area in the April surveys are spawning or spent and therefore, by definition, likely belong to the 3Ps stock. Most of the remaining adult females in Burgeo are maturing to spawn later in the same year and their stock affinities remain unclear.

Overall, cod in 3Ps appear to spawn over a significant portion of the year and at many locations within the stock area, and there appears to be no consistent peak in the spawning time. Spawning is spatially widespread and is known to occur on Burgeo Bank, St. Pierre Bank, and the Halibut Channel area, as well as inshore in Hermitage Bay (3Psa), Fortune Bay (3Psb) and Placentia Bay (3Psc). Spawning in Placentia Bay in recent years has been studied more intensively than elsewhere in 3Ps (Bolon and Schneider 1999; Lawson and Rose 1999; Bradbury et al. 2000).

8 GEAC Stratified Random Trawl Survey

In 2004, the Groundfish Enterprise Allocation Council (GEAC) carried out an eighth consecutive fall bottom-trawl survey directed at cod with the intention of creating a series of annual fall surveys in 3Ps to complement current DFO RV surveys conducted in spring. DFO provided advice on the stratified random design and catch sampling. Results of the previous surveys are reported in McClintock (1999a, b, 2000, 2001, 2002, 2003) and for the survey conducted during 1-14 December 2004 full details are given in McClintock (in prep.). These surveys are carried out in late fall and cover a large portion of offshore 3Ps, but not the Burgeo Bank area (see McClintock 2003). The commercial trawler *M.V. Pennysmart* was used in all eight surveys. Tows are of 30 min. duration using an Engels 96 high lift trawl with a 135 mm diamond mesh cod end (not lined). The trawl was fitted with rock-hopper foot-gear and Bergen #7 trawl doors. Performance of the trawl was checked onboard using Scanmar net sensors: bridge display of door-spread, opening, and clearance were recorded as well as depth and temperature. A total of 89 successful stratified random tow sets were completed in the 2004 survey. Three sets (#35, #45, and #72) were unsuccessful.

The mean cod catch per tow in 2004 was 10 fish with a mean catch weight of 31 kg; these values are substantially lower than previous surveys. The largest catch of cod was only 258 cod (compared to 2,821 cod in 2003) weighing 697 kg (compared to 8,330 kg in 2003) and this catch was taken from set 47 in stratum 319 near the mouth of the Halibut Channel at a depth of 166 m.

The trawlable biomass index for 2004 was 23 kt, substantially less than the 2003 value (69.6 kt). (Fig. 25). The biomass index has shown considerable annual variability increasing by a factor of four between 1999 and 2000 and decreasing by a factor of 2.3 between 2000 and 2001. Survey coverage during 1997 was somewhat less than in subsequent years; hence the values for 1997 are for a slightly smaller area.

The abundance index for 2004 was 6.6 million fish compared to 21.9 million fish in 2003. The abundance index is also variable, with lowest value in the 2004 survey and the highest in 2001 (Fig. 25).

In terms of age composition, the 2004 catch (expressed as mean nos. at age per tow) was dominated by 6 and 7 year old cod (i.e. the 1997 and 1998 year classes, Table 18). This is consistent with previous GEAC surveys, other stock indices, and the commercial catch which have shown that these two age classes are well represented in the population. However, the mean numbers per tow of these two ages were down substantially from the 2003 values. Subsequent age classes (1999-2001) are much weaker not only in the GEAC survey catches, but also in other stock indices as well. Further information on catches from the 2004 GEAC survey is given in McClintock (in prep.). Overall, the GEAC survey is showing considerable annual variability with a recent declining trend, similar to the DFO RV survey that covers a wider area, but is conducted in spring. The age composition of the catches from the industry and DFO surveys are also in reasonably close agreement, particularly in the most recent years. The catch-rate-at-age information from the GEAC surveys (1998-2004) is included as an abundance index in the sequential population analysis (SPA, see Section 8). The 1997 GEAC abundance index values have not been included in the SPA because a smaller area was surveyed in that year.

9 SPA analyses conducted during the previous (2004) assessment

In the 2004 assessment, results from several SPA models / formulations were presented and four were described in detail in Brattey et al. (2004). An updated summary of the inputs used in these analyses is given in Table 19. These SPA's comprised one formulation of Quasi-Likelihood SPA (QLSPA-2004, Run B), one of Extended Survivorship Analysis (XSA-2004, Run C), and two of ADAPT (ADAPT-2004 Run D and Run E) (see Brattey et al. 2004). These models were applied to the catch data from 1977 onwards. Several age-disaggregated tuning indices were available for calibrating the SPA's (though not all of them were used in each formulation). These were: the DFO winter/spring research vessel trawl survey index (RV index, split or non-split with respect to the Burgeo Bank strata, depending on the model/formulation), A. T. Cameron index, Sentinel line-trawl index, Sentinel 5½ " gillnet index, and the fall industry trawl survey (GEAC) index. The ages and years that were available for each abundance index for the 2004 assessment are described in Brattey et al. (2004).

9.1 Comparison runs and inputs available for SPA analyses in the 2005 assessment.

In the 2005 assessment, as a starting point the identical models/formulations used for providing scientific advice in the 2004 assessment were rerun using the same inputs updated with one more year of data. In addition to the commercial catch-at-age to 31 March 2005, the following abundance indices were available for these comparison runs:

Abundance Index	Ages	Years
A. T. Cameron	2-14	1977-1982
RV Index (non-split)	2-14	1983-2005
RV Index split (eastern)	2-14	1983-2005
RV Index split (western)	2-14	1993-2005
Sentinel gillnet	3-10	1995-2004
Sentinel line-trawl	3-10	1995-2004
Industry trawl (GEAC)	2-14	1997-2004

The estimation procedures used in each of these four SPA runs are essentially the same as those presented at the previous assessment (see Table 20 in Brattey et al. 2004). Inspection of plots of the model fits and the residuals (not shown) indicated that none of these runs appeared to fit the data better than any of the others and in all of these runs the fits were poor. As in the 2004 assessment, among the runs there was a wide range in the estimates of population numbers (Fig. 26a), population biomass (Fig. 26b) and spawner biomass (Fig. 26c). The overall trends were generally similar for much of the time series, except in the most recent years. A significant finding was that the addition of one more year of data had a considerable effect on the stock size estimates for the recent portion of the time period. Stock size estimates for the past 4-6 years were revised downward and retrospective patterns were evident. Close inspection of the inputs and residual plots of the model fit (not shown) showed that the commercial catches of cod were too low to account for the substantial drop in the 2004 GEAC survey and the 2005 DFO RV survey abundance indices, particularly for the 1997 and 1998 year classes. Also, in the sentinel line-trawl abundance index, catches of the 1997 and 1998 year classes were not markedly different from those of other recent cohorts at the same age.

The retrospective pattern was investigated in more detail by fitting XSA-2005 Run C using an additional year of data for successive runs for the period 2002-2005 inclusive. Trends in 3+ biomass and spawning stock biomass (Figs. 27a, b) showed a consistent retrospective pattern, with progressively lower estimates as additional years of data became available. Estimates of the strength of the 1997 and 1998 year classes were also revised progressively downward (Fig. 27c). Fishing mortality estimates (Fig. 27d) show a declining trend since 2000 in all runs (TAC's and reported landings have been largely unchanged).

9.2 Results from four SPA formulations presented at the 2005 assessment

Results from four SPA runs described above were presented at the 2005 assessment and no new formulations were investigated. These were the same four runs described in Brattey et al. (2004) and in this document these are named QLSPA-2005 Run B, XSA-2005 Run C, ADAPT-2005 Run D and ADAPT-2005 Run E, each updated with one more year of data. As in the 2004 assessment, among the runs there was a wide range in the estimates of population numbers (Fig. 28a), population biomass (Fig. 28b) and spawner biomass (Fig. 28c). The overall trends were generally similar for much of the time series, except in the most recent years.

Note that in the 2005 assessment, the two ADAPT formulations described above were used in the Stock Status Report (DFO, 2005) to illustrate the uncertainty in absolute estimates of stock size and to show trends in stock size. One of the ADAPT formulations incorporated a domed selectivity pattern (referred to as ADAPT-2005 Run D in this document, but Run 1 in the Stock Status Report) and the other a flat topped selectivity pattern (referred to as ADAPT-2005 Run E in this document, but Run 2 in the Stock Status Report). It is emphasized that these two analyses are not considered to be "preferred" or "accepted" relative to the other SPA runs. These two analyses incorporate opposing assumptions about commercial fishery selectivity.

The estimates of 3+ population numbers from the four SPA analyses show a persistent decline from a peak in the early to mid-1980's to a minimum through the mid 1990s (Fig. 28a). Stock numbers did not increase much during the moratorium (August 1993- May 1997) because recruitment was poor at that time (see below). During 1998-2000 population numbers increased, but they have subsequently declined in the most recent period (2000-2005). The peak around 2000-2001 appears to be driven largely by the stronger incoming 1997 and 1998 year classes with the slight decline reflecting subsequent recruitment that is weaker. ADAPT-2005 Run D tends to give the highest estimates of population numbers, particularly for the most recent period, whereas the other three runs give similar but lower estimates of population numbers. Note that for all four SPA formulations the recent peak in population numbers in the early 2000's is substantially lower than the peak estimated for the early to mid-1980s.

The estimates of the biomass of cod 3 years and older from the four SPA runs show a peak in the mid-1980s followed by a steady decline to a minimum around 1993/1994 (Fig. 28b). Following the onset of the moratorium, estimates of population biomass increased during 1994 to 1998. Population biomass subsequently leveled off or decreased slightly during 1998-2000 coincident with the resumption of fishing and an increase in the TAC from 10,000 t in 1997 to 30,000 t in 1999. During 2000 to

2003 most runs indicate only small changes in stock biomass with a slight decline in 2003-2005. The estimates of 3+ biomass from the four runs cover a broad range, particularly in the most recent period, with ADAPT-2004 Run D again giving the highest estimates. However, for all SPA formulations considered, the estimates of 3+ biomass for the early 2000's are still substantially lower than the peak estimated for the mid-1980's.

The estimates of spawning stock biomass (SSB) from the four runs all show similar temporal trends, and the estimates cover a wide range throughout the time series (Fig. 28c). Three peaks in spawner biomass are evident, one in the mid-1980s, a second in the late 1990's, and a third in 2003-2004. The most noticeable features of the trajectories for spawning stock biomass are (1) SSB declined persistently from the mid-1980s to the early 1990's, (2) SSB grew rapidly during the moratorium resulting in a recent peak in SSB that is almost as high as the peak of the mid 1980s, and (3) the estimates for SSB for 2001-2004 show a marked increase with a decline in the two most recent years. The two more recent peaks contrast with the trends described above for population numbers and 3+ biomass. A marked change in the age at maturity of cod within 3Ps (see Figs. 23A and 23B), specifically a declining age at maturity, is an important factor generating the two peaks in estimates of SSB for the post moratorium period. The increase in SSB since 2001 is generated largely by the appearance of two relatively strong year classes (1997 and 1998) that show unusually high proportions mature at young ages (i.e. ages 4 and 5, see Fig. 23B). Trends in the size and age composition of the SSB estimates from the two ADAPT formulations, where SSB is grouped into relatively young spawners (i.e. ages 3-6) and older spawners (i.e. ≥ 7), are shown in Fig. 28d. In both SPA formulations, a large proportion (40-65%) of the SSB in 2003 and 2004 was comprised of relatively young (≤6 yr old) spawners. ADAPT-2005 Run E gives a lower estimate for the overall size of the SSB but a higher estimate for the proportion of young spawners than ADAPT-2005 Run D. In both runs, the estimated proportion of young spawners dropped to 18-22% in 2005. The current spawner biomass still includes many older spawners that are thought to be more effective at producing eggs. Nonetheless, the 3Ps cod stock has produced mostly weak year classes since the early 1990's..

The size of the SSB alone may not be a sensitive measure of the reproductive and recruitment potential of the 3Ps stock (Marshall et al. 1998; Morgan and Brattey 2005). The spawning biomass in much of the post-moratorium period appears to be comprised of a higher proportion of younger females compared to the period prior to the late 1980s and may therefore not be as effective at producing recruits. Although SSB is estimated to be high in the recent period, the composition of the spawning biomass is not the same as it was in the 1970's and early 1980's and recent information on recruitment suggests that the reproductive potential of the spawning biomass in the current period may be lower.

The trends in the estimates of recruitment (numbers of 3 year olds) from the four SPA runs are generally consistent; the only exceptions are for the 3 year olds in 1992 (1989 year class) and in 2000-2001 (1997 and 1998 year classes) which are estimated to be stronger in ADAPT-2005 Run D compared to the other runs (Fig. 28e). Overall, recruitment shows considerable annual variability, but as pointed out in previous assessments, there is an overall downward trend in recruitment up to the late 1990s. All four model estimates in the current assessment suggest that the downward trend may have been temporarily ameliorated by the 1997 and 1998 year classes which appear to be much stronger than those observed throughout the early to mid-1990s. However, the model estimates of recruitment for the most recent period (1999-2002 year classes) are again weak and, as reported in the 2003 and 2004 assessments, this is cause for concern. With a succession of relatively weak year classes feeding into the exploitable population in the near future, current catch levels may not be sustainable unless recruitment improves. It is noteworthy that the SSB, although relatively large, has produced only two strong year classes in the period 1990-2001 and many of the others are among the weakest observed in the time series.

The trends in the estimates of fishing mortality (average of ages 5-10) from the four SPA runs suggest that there was a general increasing trend from about 1984 to a peak in 1992 (Fig. 28f). The rapid decline from 1992 to 1994 coincided with the moratorium, with the subsequent increasing trend following the reopening of the fishery in 1997 and increases in the TAC from 10,000 t in 1997 to 30,000 t in 1999. Estimates of fishing mortality for the post-moratorium period are low among all SPA runs, and have declined in some runs since 2001 when the TAC was reduced to 15,000 t. The post-moratorium estimates of fishing mortality are not as high as those observed for this stock in the late 1980's, but are comparable to those of the late 1970's and early 1980's when landings were much higher. Note that these estimates are for the stock as a whole; ongoing estimates of exploitation from recent tagging studies (1997-2003) suggest that fishing mortality in some local regions such as Placentia Bay may be substantially higher (see Section 6.1 and Brattey and Healey 2005).

9.3 Spawner biomass limit reference points

The precautionary approach framework under development for management of domestic fisheries requires that a spawning stock biomass limit reference point (B_{lim}) be computed for each stock. The risk that the stock may fall below this limit should be assessed with respect to catch options. In the 2004 assessment, various candidate reference points were reviewed. B_{rec} (where rec=recovery) is the lowest spawner biomass from which a secure recovery has occurred. B_{rec} is recommended as being suitable for 3Ps cod as this stock has undergone two recovery cycles since 1977. In the 2005 assessment, current spawning stock biomass was again compared in relative terms with B_{rec}, defined as the spawning stock biomass at the beginning of 1994 (i.e. 40,000 t and 12,000 t for the two respective SPA formulations). The current spawning stock biomass is 2.1 times larger and 4.0 times larger than B_{rec} for the two ADAPT SPA formulations (see Fig. 28c), respectively.

9.4 Projections

In the current assessment, 3-year deterministic projections to 1 April 2008 were carried out for the two ADAPT SPA formulations (Runs D and E). In the first year the catch was assumed to be 15,000 t which is the TAC for the 1 April 2005 – 31 March 2006 management year. Fixed annual TAC options in 2,500 t increments ranging from 5,000 t to 15,000 t were evaluated for the next two management years, i.e. the 2006/07 and 2007/08 fishing seasons. These projections were conducted to illustrate potential trends in the status of the stock over the next three years and they incorporate assumptions about growth, recruitment, maturation and both natural and fishing mortality that are consistent with recent observations.

The inputs for the projections are given in Table 21. Given that the nine months of a management cycle are in one calendar year and three months are in the next year, the TAC had to be split across the calendar years because the analyses are age based and fish increment an age on January 1 each year. In recent years the catches in 3Ps have been split in proportion 0.83 to 0.17 and this split was assumed for each projection period. The partial recruitment (PR) vector was computed from the average F's for the period 2002-2004 from the relevant SPA. For projections, the PR was calculated in each year, the average PR over three years computed for each age, and the averages were re-scaled to have a maximum of 1. The fishery has been dominated by gillnets in the recent period and most PR's consequently have a domed pattern. For recruitment during the projection period, the geometric mean numbers at age 3 in years 2003-2005 from the relevant SPA was used; i.e. data from three year classes that are estimated to be relatively weak (2000 to 2002). The instantaneous rate of natural mortality was assumed to be 0.2 per year (18%) as used in previous SPA's of 3Ps cod. The methods for estimating population weights-at-age (January 1), catch weights-at-age (mid-year), and maturity ogives are described in relevant previous sections. Given that the fishing season runs from 1 April to 31 March it is most appropriate to compare results from 1 April in one year (e.g. 2006.3) with 1 April in previous years to determine whether the population has grown or not. Furthermore, because the age composition is incremented only once each year (1 January) and beginning of year weights are applied, spawner biomass will always decrease under the combined effects of natural and fishing mortality during the 1 January to 1 April period.

In the first year of the projections the catch was assumed to be 15,000 t which is the TAC for the management year 1 April 2005 – 31 March 2006. At this catch level, the spawner biomass is estimated to decrease by approximately 6,000 t (6%) and 5,000 t (13%) for the two respective SPA formulations.

The projections for the management years 2006/07 and 2007/08 were for fixed annual catch options ranging from 5,000 to 15,000 t in 2,500 t increments. At catch options ranging from 7,500 to 15,000 t both formulations indicated that spawner biomass will decline by 1 April 2008 (Table 22). At a catch option of 5,000 t both formulations indicated a small increase (5-8%) in spawner biomass by 1 April 2008. Projection results for total abundance (3+ population numbers) and population biomass were similar to those for population biomass. Under all catch options considered for the two SPA formulations, the projected spawner biomass on 1 April 2007 was greater than the recommended B_{lim}, i.e. would remain well above a level from which a secure recovery of the stock had occurred in the past.

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Table 1. Reported landings of cod (t) from NAFO Subdiv. 3Ps, 1959 - 20 September 2005 by country and for fixed and mobile gear sectors.

	Can. (Newfoundland)		Can. (Mainland)	France			Spain	Portugal	Others	Total	TAC
	Offshore	Inshore		St. Pierre & Michelon		Metro					
Year	(Mobile)	(Fixed)	(All gears)	Inshore	Offshore	(All gears)	(All gears)	(All gears)	(All gears)		
1959	2,726	32,718	4,784	3,078		4,952	7,794	3,647	471	60,170	
1960	1,780	40,059	5,095	3,424	210	2,460	17,223	2,658	4,376	77,285	
1961	2,167	32,506	3,883	3,793	347	11,490	21,015	6,070	5,553	86,824	
1962	1,176	29,888	1,474	2,171	70	4,138	10,289	3,542	2,491	55,239	
1963	1,099	30,447	331	1,112	645	324	10,826	209	6,828	51,821	
1964	2,161	23,897	370	1,002	1,095	2,777	15,216	169	9,880	56,567	
1965	2,459	25,902	1,203	1,863	707	1,781	13,404		4,534	51,853	
1966	5,473	23,785	583	-	3,207	4,607	23,678	519	4,355	66,207	
1967	3,861	26,331	1,259	2,244		3,204	20,851	980	4,044	62,774	
1968	6,538	22,938	585	-	880	1,126	26,868	8	18,613	77,556	
1969	4,269	20,009	849	-	2,477	15	28,141	57	7,982	63,799	
1970	4,650	23,410	2,166	1,307	663	35	35,750	143	8,734	76,858	
1971	8,657	26,651	731	1,196	455	2,730	19,169	81	2,778	62,448	
1972	3,323	19,276	252	990	446	-	18,550	109	1,267	44,213	
1973	3,107	21,349	181	976	189	-	19,952	1,180	5,707	52,641	70,500
1974	3,770	15,999	657	600	348	5,366	14,937	1,246	3,789	46,712	70,000
1975	741	14,332	122	586	189	3,549	12,234	1,350	2,270	35,373	62,400
1976	2,013	20,978	317	722	182	1,501	9,236	177	2,007	37,133	47,500
1977	3,333	23,755	2,171	845	407	1,734	-	-		32,245	32,500
1978	2,082	19,560	700	360	1,614	2,860	-	-	45	27,221	25,000
1979	2,381	23,413	863	495	3,794	2,060	-	-	-	33,006	25,000
1980	2,809	29,427	715	214	1,722	2,681	-	-	-	37,568	28,000
1981	2,696	26,068	2,321	333	3,768	3,706	-	-	-	38,892	30,000
1982	2,639	21,351	2,948	1,009	3,771	2,184	-	-	-	33,902	33,000
1983	2,100	23,915	2,580	843	4,775	4,238	-	-	-	38,451	33,000
1984	895	22,865	1,969	777	6,773	3,671	-	-	-	36,950	33,000
1985	4,529	24,854	3,476	642	9,422	8,444	-	-	-	51,367	41,000
1986	5,218	24,821	1,963	389	13,653	11,939	-	-	7	57,990	41,000
1987	4,133	26,735	2,517	551	15,303	9,965	-	-	-	59,204	41,000
1988	3,662	19,742	2,308	282	10,011	7,373	-	-	4	43,382	41,000
1989	3,098	23,208	2,361	339	9,642	892	-	-	-	39,540	35,400
1990	3,266	20,128	3,082	158	14,771	-	-	-	-	41,405	35,400
1991	3,916	21,778	2,106	204	15,585	-	-	-	-	43,589	35,400
1992	4,468	19,025	2,238	2	10,162	-	-	-	-	35,895	35,400
1993	1,987	11,878	1,351	-	-	-	-	-	-	15,216	20,000
1994	82	493	86	-	-	-	-	-	-	661	0
1995	26	555	60	-	-	-	-	-	-	641	0
1996	60	707 [2]	118							885	0
1997 [1]	122	7,205 [2]	79	448	1,191					9,045	10,000
1998 [1]	4,320	11,370 [2]	885	609	2,511					19,694	20,000
1999 [1]	3,097	21,231 [2]	614	621	2,548					28,111	30,000
2000 [1]	3,436	16,247 [2]	740	870	3,807					25,100 [4]	20,000
2001 [1]	2,152	11,187 [2]	856	675	1,675					16,546 [4]	15,000
2002 [1]	1,326	11,292 [2]	499	579	1,623					14,892 [4]	15,000
2003 [1]	1,869	10,600 [2]	412	734	1,645					15,260 [4]	15,000
2004 [1]	1,595	9,450 [2]	790	465	2,113					14,414 [4]	15,000
2005 [3]	1,761	5,343	544	0	1,033					8,681 [4]	15,000

[1] Provisional catches

[2] Includes recreational fishery and sentinel fishery.

[3] Catch for Canada and France to 20 September 2005.

[4] TAC's are now set for the period 1 April to 31 March rather than by calender year and the TAC was 20,000 t for 2000-2001, and 15,000 t for subsequent management years.

Table 2. Reported fixed gear catches of cod (t) from NAFO Subdivision 3Ps by gear type. (Includes non-Canadian and recreational catch)

Year	Gillnet	Longline	Handline	Trap	Total
1975	4,995	4,083	1,364	3,902	14,344
1976	5,983	5,439	2,346	7,224	20,992
1977	3,612	9,940	3,008	7,205	23,765
1978	2,374	11,893	3,130	2,245	19,642
1979	3,955	14,462	3,123	2,030	23,570
1980	5,493	19,331	2,545	2,077	29,446
1981	4,998	20,540	1,142	948	27,628
1982	6,283	13,574	1,597	1,929	23,383
1983	6,144	12,722	2,540	3,643	25,049
1984	7,275	9,580	2,943	3,271	23,069
1985	7,086	10,596	1,832	5,674	25,188
1986	8,668	11,014	1,634	4,073	25,389
1987	9,304	11,807	1,628	4,931	27,670
1988	6,433	10,175	1,469	2,449	20,526
1989	5,997	10,758	1,657	5,996	24,408
1990	6,948	8,792	2,217	3,788	21,745
1991	6,791	10,304	1,832	4,068	22,995
1992	5,314	10,315	1,330	3,397	20,356
1993	3,975	3,783	1,204	3,557	12,519
1994	90	0	381	0	471
1995	383	182	0	5	570
1996	467	158	137	10	772
1997[1]	3,760	1,158	1,172	1,167	7,258
1998[1]	10,116	2,914	308	92	13,430
1999[1]	17,976	3,714	503	45	22,237
2000[1]	14,218	3,100	186	56	17,561
2001[1]	7,377	2,833	2,089	57	12,357
2002[1]	7,827	2,309	775	119	11,030
2003[1]	8,313	2,044	546	35	10,937
2004[1]	7,910	2,167	415	15	10,508
2005[2]	4,936	632	254	6	5,828

[1] provisional catch

[2] catch to 20 September 2005

Table 3a. Reported monthly landings (t) of cod from the inshore and offshore of NAFO Subdiv. 3Ps by gear type during 2004 and 2005 (to 20 September).

2004	Offshore			Inshore					
MONTH	Otter trawl	Gillnet	Line trawl	Gillnet	Line trawl	Handline	Trap	Otter trawl	*Total
Jan	1,574.7	72.1	87.5	64.5	79.0	0.7	0.0	0.0	1,878.6
Feb	1,286.7	9.6	44.1	12.0	1.6	0.1	0.0	0.3	1,354.6
Mar	146.6	0.0	13.6	0.0	0.5	0.0	0.0	18.8	179.5
Apr	0.7	0.0	31.5	1.4	1.9	0.0	0.0	0.0	35.5
May	0.0	0.0	3.6	317.3	27.1	3.8	3.2	0.0	355.1
Jun	0.0	52.1	41.1	1,641.7	74.0	27.8	6.5	0.0	1,843.1
Jul	0.0	435.5	9.9	1,488.4	103.3	45.3	2.9	0.0	2,085.3
Aug	0.0	306.7	27.3	251.1	236.5	206.4	2.9	0.0	1,030.9
Sep	17.9	302.1	14.7	226.1	225.1	53.9	0.0	0.0	839.8
Oct	4.4	591.0	9.1	343.9	436.4	38.9	0.0	0.0	1,423.7
Nov	418.3	465.0	38.7	1,118.6	363.4	31.7	0.0	3.4	2,439.1
Dec	423.9	7.5	74.1	203.6	222.5	6.9	0.0	8.8	947.3
TOTAL	3,873.3	2,241.5	395.3	5,668.7	1,771.4	415.4	15.4	31.4	14,412.5

*total excludes 1.5 t of landings from other gear types

2005	Offshore			Inshore					
MONTH	Otter trawl	Gillnet	Line trawl	Gillnet	Line trawl	Handline	Trap	Otter trawl	Total
Jan	876.2	0.0	20.2	166.7	86.2	0.9	0.0	0.9	1,151.1
Feb	1,430.8	60.1	170.7	103.6	25.4	0.0	0.0	3.1	1,793.6
Mar	514.9	21.0	9.0	0.5	0.0	0.0	0.5	1.0	546.8
Apr	7.5	0.0	13.9	0.2	2.0	0.0	0.0	0.1	23.7
May	0.0	0.0	10.6	201.0	13.0	0.8	0.7	0.0	226.1
Jun	0.0	15.0	0.1	1,366.8	58.8	31.7	4.8	0.0	1,477.2
Jul	0.0	165.7	13.0	1,404.8	87.6	161.5	0.0	0.0	1,832.5
Aug	18.7	195.0	8.5	1,234.6	113.6	59.5	0.0	0.0	1,629.9
Sep	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Oct	.	.	.	.	.	.	.	.	.
Nov	.	.	.	.	.	.	.	.	.
Dec	.	.	.	.	.	.	.	.	.
TOTAL	2,848.1	457.5	246.0	4,478.2	386.4	254.4	6.0	5.0	8,681.6

Table 3b. Reported monthly landings (t) of cod from unit areas in NAFO Subdiv. 3Ps during 2004 and 2005 (to 20 September).

2004	Inshore			Offshore					
Month	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	**Totals**
Jan	15.2	67.5	61.6	43.6	0.0	0.0	14.9	1,675.9	1,878.6
Feb	6.9	6.1	1.1	133.7	0.0	14.6	20.7	1,171.4	1,354.6
Mar	19.1	0.2	0.0	49.3	0.0	0.2	3.4	107.3	179.5
Apr	1.5	0.5	1.4	0.1	0.0	0.0	0.6	31.5	35.5
May	77.8	137.3	136.4	0.0	0.3	0.0	0.0	3.3	355.2
Jun	170.8	411.5	1,167.7	8.8	10.2	39.8	0.1	34.3	1,843.2
Jul	179.2	347.3	1,113.4	97.9	98.0	212.8	15.3	21.4	2,085.3
Aug	288.0	128.1	280.8	58.8	212.9	44.7	2.2	15.3	1,030.9
Sep	192.3	160.8	152.3	8.4	194.3	101.8	0.0	30.3	840.1
Oct	291.9	268.3	259.7	6.1	229.5	336.0	11.7	21.3	1,424.5
Nov	112.1	410.4	994.5	21.8	80.5	488.7	80.5	250.5	2,439.0
Dec	48.4	174.7	218.9	0.3	5.7	0.5	52.3	446.8	947.6
Totals	1,403.2	2,112.7	4,387.9	428.8	831.3	1,239.0	201.7	3,809.4	14,414.0

2005	Inshore			Offshore					
Month	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	**Totals**
Jan	29.3	76.3	149.1	29.4	0.0	121.5	2.9	742.7	1,151.1
Feb	10.5	86.1	35.4	13.0	0.0	4.7	4.4	1,639.4	1,793.6
Mar	1.0	0.0	0.5	4.4	10.5	0.0	1.0	528.9	546.3
Apr	1.0	0.9	0.3	0.0	0.0	0.0	4.0	17.4	23.7
May	49.6	118.6	47.0	2.2	0.0	0.0	0.3	8.1	225.9
Jun	162.3	352.5	942.5	14.4	0.0	0.5	0.0	0.2	1,472.4
Jul	148.8	601.0	904.9	41.4	26.7	100.9	0.0	9.7	1,833.3
Aug	174.5	577.3	660.8	81.5	54.5	34.8	15.9	35.5	1,634.8
Sep	.	.	.	0.8	.	.	.	.	0.8
Oct	.	.	.	.	.	.	.	.	.
Nov	.	.	.	.	.	.	.	.	.
Dec	.	.	.	.	.	.	.	.	.
Totals	577.0	1,812.8	2,740.5	187.1	91.7	262.4	28.4	2,981.8	8,681.8

Table 3c. Reported monthly landings (t) of cod from unit areas in NAFO Subdiv. 3Ps during the management year 1 April 2004 to 31 March 2005

	Inshore			Offshore					
2004	**3Psa**	**3Psb**	**3Psc**	**3Psd**	**3Pse**	**3Psf**	**3Psg**	**3Psh**	**Totals**
Apr	1.5	0.5	1.4	0.1	0.0	0.0	0.6	31.5	35.5
May	77.8	137.3	136.4	0.0	0.3	0.0	0.0	3.3	355.2
Jun	170.8	411.5	1,167.7	8.8	10.2	39.8	0.1	34.3	1,843.2
Jul	179.2	347.3	1,113.4	97.9	98.0	212.8	15.3	21.4	2,085.3
Aug	288.0	128.1	280.8	58.8	212.9	44.7	2.2	15.3	1,030.9
Sep	192.3	160.8	152.3	8.4	194.3	101.8	0.0	30.3	840.1
Oct	291.9	268.3	259.7	6.1	229.5	336.0	11.7	21.3	1,424.5
Nov	112.1	410.4	994.5	21.8	80.5	488.7	80.5	250.5	2,439.0
Dec	48.4	174.7	218.9	0.3	5.7	0.5	52.3	446.8	947.6
2005									
Jan	29.3	76.3	149.1	29.4	0.0	121.5	2.9	742.7	1,151.1
Feb	10.5	86.1	35.4	13.0	0.0	4.7	4.4	1,639.4	1,793.6
Mar	1.0	0.0	0.5	4.4	10.5	0.0	1.0	528.9	546.3
Totals	1402.8	2201.3	4510.2	249.0	841.9	1350.4	171.0	3765.7	14492.3

Table 4a. Number of cod sampled for length and age and available to estimate the commercial catch at age for 2004.

	Number Measured							
	Offshore			Inshore				
Month	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Trap	Totals
Jan	3,737	247	285	1,704	6,461	77		12,511
Feb	4,119				285			4,404
Mar	1,378				168			1,546
Apr								0
May				2,072	503	109	616	3,300
Jun		310		7,329	217	444	595	8,895
Jul		7,815		7,808	2,460	108		18,191
Aug		291		2,404	4,775	1,175		8,645
Sep		463		3,205	3,930	145		7,743
Oct	588	727		363	2,298	34		4,010
Nov	2,075	396		1,887	6,012			10,370
Dec	504			12				516
	12,401	10,249	285	26,784	27,109	2,092	1,211	80,131

	Number Aged							
	Offshore			Inshore				
Qtr	Ottertrawl	Gillnet	Linetrawl	Trap	Gillnets	Linetrawl	Handline	Totals
1	1,222	116	102		176	223	31	1,870
2				134	785	146	52	1,117
3		545		97	1,289	795	378	3,104
4	266	183			546	857		1,852
	1,488	844	102	231	2,796	2,021	461	7,943

Sampling by France for 2004 catch at age				
Qtr	Ottertrawl	Gillnet	Ottertrawl	Gillnet
	Measured		Aged	
1	1,004		200	
3		1,273		
4	3,200			
Total	4,204	1,273	200	0

Table 4b. Number of cod sampled for length and age and available to estimate the commercial catch at age for Jan.-Mar. 2005

	Number Measured							
	Offshore			Inshore				
Month	Ottertrawl	Gillnet	Linetrawl	Gillnet	Linetrawl	Handline	Trap	Totals
Jan	2,149			2,678	1,217			3,895
Feb	4,874			44	705			749
Mar	1,689			59	24			83
	8,712	0	0	2,781	1,946	0	0	13,439

	Number Aged							
	Offshore			Inshore				
Qtr	Ottertrawl	Gillnet	Linetrawl	Trap	Gillnets	Linetrawl	Handline	Totals
1	1,423	0	0		448	161	0	2,032
2								
3								
4								
	1,423	0	0	0	448	161	0	2,032

Sampling by France for Jan -Mar 2005 catch at age					
Qtr	Ottertrawl	Gillnet	Ottertrawl	Gillnet	
	Measured		Aged		
1	4,105		383		
Total	4,105		383		

Table 5a. Estimates of average weight (kg), length (cm), and numbers-at-age (000's) for Canadian landings together with French catch and the resulting total catch numbers-at-age for cod in 3Ps during 2004

	AVERAGE		CATCH			Total
AGE	WEIGHT (kg.)	LENGTH (cm.)	NUMBER (000'S)	STD ERR.	CV	NUMBER (000'S)
1	0.00	0.00	0.00	0.00		0
2	0.28	32.24	3.66	1.22		4
3	0.59	40.32	62.03	3.67	0.06	62
4	0.96	47.66	112.63	7.08	0.06	113
5	1.37	53.34	653.51	19.40	0.03	654
6	2.04	60.41	1592.28	34.47	0.02	1592
7	2.49	64.64	1712.55	39.44	0.02	1713
8	2.74	66.37	649.18	26.41	0.04	649
9	2.85	66.89	266.25	19.29	0.07	266
10	5.02	79.15	180.31	14.74	0.08	180
11	6.71	88.14	103.63	9.22	0.09	104
12	5.25	81.07	47.42	4.73	0.10	47
13	7.13	89.54	16.68	1.67	0.10	17
14	8.79	96.17	23.94	5.56	0.23	24
15	12.12	108.06	28.54	3.78	0.13	29
16	12.69	110.17	2.81	0.58	0.21	3
17	8.71	97.30	0.15	0.12	0.81	0
18	20.75	130.00	0.05	0.06	1.11	0
19	0.00	0.00	0.00	0.00		0
20	9.23	100.00	0.20	0.16	0.76	0
21	0.00	0.00	0.00	0.00		0
22	0.00	0.00	0.00	0.00		0
23	0.00	0.00	0.00	0.00		0
24	0.00	0.00	0.00	0.00		0
25	0.00	0.00	0.00	0.00		0

Table 5b. Estimates of average weight (kg), length (cm), and numbers-at-age (000's) for Canadian landings together with French catch and the resulting total catch numbers-at-age for cod in 3Ps during Jan.-Mar. 2005

	AVERAGE		CATCH			Total
AGE	WEIGHT (kg.)	LENGTH (cm.)	NUMBER (000'S)	STD ERR.	CV	NUMBER (000'S)
1	0.00	0.00	0.00	0.00		0
2	0.00	0.00	0.00	0.00		0
3	0.34	34.28	0.02	0.00	0.11	0
4	0.74	43.75	12.38	1.48	0.12	12
5	1.24	51.35	32.37	3.09	0.10	32
6	1.67	56.82	98.60	6.08	0.06	99
7	2.43	64.11	344.07	10.78	0.03	344
8	3.10	69.04	282.49	10.05	0.04	282
9	3.76	73.26	109.78	6.22	0.06	110
10	4.55	76.61	15.03	1.77	0.12	15
11	7.47	90.84	25.46	2.11	0.08	25
12	8.98	97.78	15.03	1.63	0.11	15
13	9.28	99.44	6.10	0.89	0.15	6
14	10.76	102.05	4.12	0.76	0.18	4
15	13.27	111.70	16.79	1.37	0.08	17
16	14.04	113.79	16.89	1.48	0.09	17
17	13.01	111.30	2.12	0.51		2
18	17.93	124.00	0.23	0.12	0.50	0
19	14.99	116.30	0.49	0.25		0
20	0.00	0.00	0.00	0.00		0
21	0.00	0.00	0.00	0.00		0
22	0.00	0.00	0.00	0.00		0
23	25.52	139.00	0.16	0.00		0
24	0.00	0.00	0.00	0.00		0
25	0.00	0.00	0.00	0.00		0

Table 6. Catch numbers-at-age (000s) for the commercial cod fishery in NAFO Subdiv. 3Ps from 1959 to 31 March 2005.

Year/Age	3	4	5	6	7	8	9	10	11	12	13	14
1959	1,001	13,940	7,525	7,265	4,875	942	1,252	1,260	631	545	44	1
1960	567	5,496	23,704	6,714	3,476	3,484	1,020	827	406	407	283	27
1961	450	5,586	10,357	15,960	3,616	4,680	1,849	1,376	446	265	560	58
1962	1,245	6,749	9,003	4,533	5,715	1,367	791	571	187	140	135	241
1963	961	4,499	7,091	5,275	2,527	3,030	898	292	143	99	107	92
1964	1,906	5,785	5,635	5,179	2,945	1,881	1,891	652	339	329	54	27
1965	2,314	9,636	5,799	3,609	3,254	2,055	1,218	1,033	327	68	122	36
1966	949	13,662	13,065	4,621	5,119	1,586	1,833	1,039	517	389	32	22
1967	2,871	10,913	12,900	6,392	2,349	1,364	604	316	380	95	149	3
1968	1,143	12,602	13,135	5,853	3,572	1,308	549	425	222	111	5	107
1969	774	7,098	11,585	7,178	4,554	1,757	792	717	61	120	67	110
1970	756	8,114	12,916	9,763	6,374	2,456	730	214	178	77	121	14
1971	2,884	6,444	8,574	7,266	8,218	3,131	1,275	541	85	125	62	57
1972	731	4,944	4,591	3,552	4,603	2,636	833	463	205	117	48	45
1973	945	4,707	11,386	4,010	4,022	2,201	2,019	515	172	110	14	29
1974	1,887	6,042	9,987	6,365	2,540	1,857	1,149	538	249	80	32	17
1975	1,840	7,329	5,397	4,541	5,867	723	1,196	105	174	52	6	2
1976	4,110	12,139	7,923	2,875	1,305	495	140	53	17	21	4	3
1977	935	9,156	8,326	3,209	920	395	265	117	57	43	31	11
1978	502	5,146	6,096	4,006	1,753	653	235	178	72	27	17	10
1979	135	3,072	10,321	5,066	2,353	721	233	84	53	24	13	10
1980	368	1,625	5,054	8,156	3,379	1,254	327	114	56	45	21	25
1981	1,022	2,888	3,136	4,652	5,855	1,622	539	175	67	35	18	2
1982	130	5,092	4,430	2,348	2,861	2,939	640	243	83	30	11	7
1983	760	2,682	9,174	4,080	1,752	1,150	1,041	244	91	37	18	8
1984	203	4,521	4,538	7,018	2,221	584	542	338	134	35	8	8
1985	152	2,639	8,031	5,144	5,242	1,480	626	545	353	109	21	6
1986	306	5,103	10,253	11,228	4,283	2,167	650	224	171	143	79	23
1987	585	2,956	11,023	9,763	5,453	1,416	1,107	341	149	78	135	50
1988	935	4,951	4,971	6,471	5,046	1,793	630	284	123	75	53	31
1989	1,071	8,995	7,842	2,863	2,549	1,112	600	223	141	57	29	26
1990	2,006	8,622	8,195	3,329	1,483	1,237	692	350	142	104	47	22
1991	812	7,981	10,028	5,907	2,164	807	620	428	108	76	50	22
1992	1,422	4,159	8,424	6,538	2,266	658	269	192	187	83	34	41
1993	278	3,712	2,035	3,156	1,334	401	89	38	52	13	14	5
1994	9	78	173	74	62	28	12	3	2	0	0	0
1995	3	7	56	119	57	37	7	2	0	0	0	0
1996	9	43	43	101	125	35	24	8	2	1	0	0
1997	66	427	1,130	497	937	826	187	93	31	4	1	0
1998	91	373	793	1,550	948	1,314	1,217	225	120	56	15	1
1999	49	628	1,202	2,156	2,321	1,020	960	873	189	110	21	8
2000	76	335	736	1,352	1,692	1,484	610	530	624	92	37	16
2001	80	475	718	1,099	1,143	796	674	257	202	192	28	13
2002	155	607	1,451	1,280	900	722	419	355	96	70	71	14
2003	15	301	879	1,810	1,139	596	337	277	167	67	55	84
2004	62	113	654	1,592	1,713	649	266	180	104	47	17	24
2005*	0	12	32	99	344	282	110	15	25	15	6	4

* January-March 2005 only

Table 7a. Annual mean weights-at-age (kg) calculated from lengths-at-age based on samples of the catch by commercial fisheries (including food fisheries and sentinel surveys) in Subdividion 3Ps in 1959-2005. The weights-at-age from 1976 are extrapolated back to 1959. The 2005 weights are geometric means of the 2002-2004 values.

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1959	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1960	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1961	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1962	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1963	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1964	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1965	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1966	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1967	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1968	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1969	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1970	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1971	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1972	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1973	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1974	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1975	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1976	0.28	0.69	1.08	1.68	2.40	3.21	4.10	5.08	6.03	7.00	8.05	9.16
1977	0.55	0.68	1.30	1.86	2.67	3.42	4.19	4.94	5.92	6.76	8.78	10.90
1978	0.45	0.70	1.08	1.75	2.45	2.99	4.10	5.16	5.17	7.20	7.75	8.72
1979	0.41	0.65	1.01	1.65	2.55	3.68	4.30	6.49	7.00	8.20	9.53	10.84
1980	0.52	0.72	1.13	1.66	2.48	3.60	5.40	6.95	7.29	8.64	9.33	9.58
1981	0.48	0.79	1.32	1.80	2.30	3.27	4.36	5.68	7.41	9.04	8.39	9.56
1982	0.45	0.77	1.17	1.78	2.36	2.88	3.91	5.28	6.18	8.62	8.64	11.41
1983	0.58	0.84	1.33	1.99	2.58	3.26	3.77	5.04	6.56	8.45	10.06	11.82
1984	0.66	1.04	1.40	1.97	2.64	3.77	4.75	5.56	6.01	9.04	11.20	10.40
1985	0.63	0.85	1.23	1.79	2.81	3.44	5.02	6.01	6.11	7.18	9.81	10.48
1986	0.54	0.75	1.18	1.84	2.43	3.15	4.30	5.50	6.19	8.72	8.05	11.91
1987	0.56	0.77	1.21	1.63	2.31	3.02	4.33	5.11	6.20	6.98	7.08	8.34
1988	0.63	0.82	1.09	1.67	2.17	2.92	3.58	4.98	5.61	6.60	7.46	8.92
1989	0.63	0.81	1.16	1.63	2.25	3.37	4.11	5.18	6.29	7.30	7.75	8.73
1990	0.58	0.86	1.27	1.85	2.45	3.00	4.22	5.09	6.35	7.60	8.31	10.37
1991	0.60	0.75	1.17	1.74	2.37	2.91	3.69	4.23	6.34	7.68	8.64	9.72
1992	0.46	0.69	1.04	1.56	2.23	2.89	4.14	5.54	6.42	7.82	10.40	11.88
1993	0.36	0.68	1.08	1.48	2.13	2.82	4.34	4.30	4.68	7.49	6.85	8.24
1994	0.62	0.82	1.30	1.86	2.05	2.75	3.59	4.38	6.29	7.77	6.78	8.07
1995	0.52	0.85	1.57	2.03	2.47	2.78	3.46	4.30	4.27	4.16	5.59	9.24
1996	0.67	0.98	1.48	2.05	2.53	2.94	3.23	4.03	4.82	4.68	7.26	9.92
1997	0.62	0.90	1.30	1.87	2.51	3.24	3.47	3.52	4.59	6.37	8.58	10.73
1998	0.62	1.02	1.57	2.05	2.42	3.10	4.04	4.13	4.62	5.21	6.39	9.69
1999	0.70	0.92	1.57	2.31	2.53	2.82	3.92	5.32	4.99	5.27	6.14	7.27
2000	0.62	0.90	1.36	2.07	2.74	2.81	3.15	4.60	6.54	6.12	6.42	7.73
2001	0.69	1.02	1.44	1.94	2.57	3.41	3.21	3.46	5.59	8.61	7.61	8.11
2002	0.57	1.02	1.54	2.04	2.32	3.10	4.33	3.90	3.87	6.05	8.89	7.94
2003	0.68	0.97	1.57	2.11	2.34	2.63	3.87	4.75	4.30	5.33	7.82	10.35
2004	0.59	0.96	1.37	2.04	2.49	2.74	2.85	5.02	6.71	5.25	7.13	8.79
2005	0.61	0.98	1.49	2.06	2.39	2.82	3.63	4.53	4.82	5.53	7.91	8.97

Table 7b. Beginning of the year weights-at-age calculated from commercial annual mean weights-at-age, as described in Lilly (MS 1998). The values for 2005 are geometric means of the 2002-2004 values.

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1959	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1960	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1961	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1962	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1963	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1964	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1965	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1966	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1967	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1968	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1969	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1970	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1971	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1972	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1973	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1974	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1975	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1976	0.18	0.44	0.86	1.35	2.01	2.78	3.63	4.56	5.53	6.50	7.51	8.59
1977	0.49	0.44	0.95	1.42	2.12	2.86	3.67	4.50	5.48	6.38	7.84	9.37
1978	0.37	0.62	0.86	1.51	2.13	2.83	3.74	4.65	5.05	6.53	7.24	8.75
1979	0.31	0.54	0.84	1.33	2.11	3.00	3.59	5.16	6.01	6.51	8.28	9.17
1980	0.42	0.54	0.86	1.29	2.02	3.03	4.46	5.47	6.88	7.78	8.75	9.55
1981	0.38	0.64	0.97	1.43	1.95	2.85	3.96	5.54	7.18	8.12	8.51	9.44
1982	0.33	0.61	0.96	1.53	2.06	2.57	3.58	4.80	5.92	7.99	8.84	9.78
1983	0.43	0.61	1.01	1.53	2.14	2.77	3.30	4.44	5.89	7.23	9.31	10.11
1984	0.58	0.78	1.08	1.62	2.29	3.12	3.94	4.58	5.50	7.70	9.73	10.23
1985	0.58	0.75	1.13	1.58	2.35	3.01	4.35	5.34	5.83	6.57	9.42	10.83
1986	0.45	0.69	1.00	1.50	2.09	2.98	3.85	5.25	6.10	7.30	7.60	10.81
1987	0.46	0.64	0.95	1.39	2.06	2.71	3.69	4.69	5.84	6.57	7.86	8.19
1988	0.56	0.68	0.92	1.42	1.88	2.60	3.29	4.64	5.35	6.40	7.22	7.95
1989	0.54	0.71	0.98	1.33	1.94	2.70	3.46	4.31	5.60	6.40	7.15	8.07
1990	0.51	0.74	1.01	1.46	2.00	2.60	3.77	4.57	5.74	6.91	7.79	8.96
1991	0.56	0.66	1.00	1.49	2.09	2.67	3.33	4.22	5.68	6.98	8.10	8.99
1992	0.38	0.65	0.88	1.35	1.97	2.62	3.47	4.52	5.21	7.04	8.94	10.13
1993	0.23	0.56	0.86	1.24	1.82	2.51	3.54	4.22	5.09	6.94	7.32	9.25
1994	0.53	0.54	0.94	1.42	1.74	2.42	3.19	4.36	5.20	6.03	7.13	7.43
1995	0.38	0.72	1.13	1.63	2.14	2.39	3.08	3.93	4.32	5.12	6.59	7.92
1996	0.58	0.72	1.12	1.79	2.26	2.70	3.00	3.73	4.55	4.47	5.49	7.45
1997	0.48	0.78	1.13	1.67	2.27	2.86	3.20	3.37	4.30	5.54	6.34	8.83
1998	0.51	0.79	1.19	1.63	2.13	2.79	3.62	3.79	4.03	4.89	6.38	9.12
1999	0.62	0.76	1.27	1.90	2.28	2.61	3.49	4.64	4.54	4.93	5.66	6.82
2000	0.48	0.79	1.12	1.80	2.52	2.67	2.98	4.25	5.90	5.53	5.82	6.89
2001	0.57	0.79	1.14	1.62	2.31	3.06	3.00	3.30	5.07	7.50	6.83	7.22
2002	0.44	0.84	1.25	1.71	2.12	2.83	3.84	3.53	3.66	5.82	8.75	7.77
2003	0.57	0.75	1.27	1.81	2.19	2.47	3.46	4.53	4.09	4.54	6.88	9.59
2004	0.52	0.81	1.15	1.79	2.29	2.53	2.74	4.41	5.64	4.75	6.16	8.29
2005	0.52	0.80	1.22	1.77	2.20	2.61	3.32	4.13	4.39	5.01	7.18	8.52

Table 8. Standardized gillnet (5.5 in mesh) and line-trawl annual catch rate-at-age indices estimated using data from sentinel fishery fixed sites. Catch rates are fish per net for gill nets and fish per 1000 hooks for line-trawl. The 1997 and 1998 cohorts are shaded.

Gill net				**Age**					
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Totals**
1995	0.02	0.11	4.76	10.02	5.84	2.81	0.37	0.14	23.85
1996	0.01	0.25	2.49	11.54	9.54	2.75	0.81	0.07	28.22
1997	0.01	0.24	5.47	5.09	8.55	7.65	0.94	0.68	28.66
1998	0.00	0.04	0.89	6.10	2.95	2.16	1.36	0.31	13.68
1999	0.06	0.07	0.55	0.90	1.42	0.63	0.30	0.29	5.41
2000	0.01	0.03	0.28	0.66	0.64	0.85	0.28	0.10	2.91
2001	0.03	0.16	0.39	0.80	0.62	0.33	0.30	0.13	2.81
2002	0.00	0.04	0.54	0.91	0.87	0.37	0.18	0.19	3.15
2003	0.01	0.05	0.21	0.89	0.42	0.14	0.07	0.03	1.84
2004	0.00	0.06	0.20	0.77	0.79	0.33	0.10	0.02	2.26

Linetrawl				**Age**					
Year	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Totals**
1995	10.46	19.60	62.95	87.52	22.84	17.33	3.71	1.81	226.23
1996	9.31	33.52	31.70	50.44	51.84	14.46	8.03	1.88	201.17
1997	6.48	27.27	27.13	18.16	17.06	24.11	2.36	1.80	124.36
1998	8.65	19.24	22.32	17.49	6.49	9.76	11.51	2.07	97.54
1999	5.71	15.76	20.29	14.58	6.90	5.32	3.94	1.58	74.08
2000	15.97	34.39	32.18	21.17	9.29	8.06	2.65	1.13	124.84
2001	20.21	30.84	21.86	12.29	7.18	4.41	2.48	0.79	100.05
2002	14.20	29.63	26.85	9.38	5.79	2.00	1.11	0.87	89.83
2003	2.72	33.33	35.09	17.82	7.73	3.22	1.15	0.64	101.70
2004	9.86	10.28	36.21	19.72	10.03	3.29	1.57	0.45	91.42

Table 8. Standardized gillnet (5.5 in mesh) and line-trawl annual catch rate-at-age indices estimated using data from sentinel fishery fixed sites. Catch rates are fish per net for gill nets and fish per 1000 hooks for line-trawl. The 1997 and 1998 cohorts are shaded.

Gill net	Age								
Year	3	4	5	6	7	8	9	10	Totals
1995	0.02	0.11	4.76	10.02	5.84	2.81	0.37	0.14	23.85
1996	0.01	0.25	2.49	11.54	9.54	2.75	0.81	0.07	28.22
1997	0.01	0.24	5.47	5.09	8.55	7.65	0.94	0.68	28.66
1998	0.00	0.04	0.89	6.10	2.95	2.16	1.36	0.31	13.68
1999	0.06	0.07	0.55	0.90	1.42	0.63	0.30	0.29	5.41
2000	0.01	0.03	0.28	0.66	0.64	0.85	0.28	0.10	2.91
2001	0.03	0.16	0.39	0.80	0.62	0.33	0.30	0.13	2.81
2002	0.00	0.04	0.54	0.91	0.87	0.37	0.18	0.19	3.15
2003	0.01	0.05	0.21	0.89	0.42	0.14	0.07	0.03	1.84
2004	0.00	0.06	0.20	0.77	0.79	0.33	0.10	0.02	2.26

Linetrawl	Age								
Year	3	4	5	6	7	8	9	10	Totals
1995	10.46	19.60	62.95	87.52	22.84	17.33	3.71	1.81	226.23
1996	9.31	33.52	31.70	50.44	51.84	14.46	8.03	1.88	201.17
1997	6.48	27.27	27.13	18.16	17.06	24.11	2.36	1.80	124.36
1998	8.65	19.24	22.32	17.49	6.49	9.76	11.51	2.07	97.54
1999	5.71	15.76	20.29	14.58	6.90	5.32	3.94	1.58	74.08
2000	15.97	34.39	32.18	21.17	9.29	8.06	2.65	1.13	124.84
2001	20.21	30.84	21.86	12.29	7.18	4.41	2.48	0.79	100.05
2002	14.20	29.63	26.85	9.38	5.79	2.00	1.11	0.87	89.83
2003	2.72	33.33	35.09	17.82	7.73	3.22	1.15	0.64	101.70
2004	9.86	10.28	36.21	19.72	10.03	3.29	1.57	0.45	91.42

Table 9. Cod abundance estimates (000's of fish) from DFO bottom-trawl research vessel surveys in NAFO Division 3Ps (1983-2005 shown). Shaded cells are model estimates.

		Vessel	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		Trips	9	26	26	45	55+56	68	81	91	103	118	133	135	150-151	166-167	186-187	202-203	219-220	236-237	313-316	364-365	418-419	476-477	523+546	617-618
		Sets	164	93	109	136	130	146	146	108	158	137	136	130	166	161	148	158	178	175	171	173	177	176	177	178
		Mean Date	30-Apr	13-Apr	13-Mar	15-Mar	7-Mar	5-Feb	9-Feb	9-Feb	10-Feb	14-Feb	13-Feb	11-Apr	15-Apr	16-Apr	22-Apr	12-Apr-97	21-Apr	24-Apr	21-Apr	18-Apr	15-Apr	22-Apr	24-Apr	27-Apr
Depth range (fathoms)	Strata	sq. mi.	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
<30	314	974	2527	134	96	0	0	211	30	45	0	0	0	0	74	0	0	77	57	1729	1531	153	67	19	117	256
	320	1320	3424	3473	1089	262	248	383	853	0	620	20	0	0	0	0	545	303	1292	3546	5183	1543	478	1601	396	523
31-50	293 [5]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	107	292	601	394	219	131	120	375	2850
	308	112	627	801	1741	0	169	247	15	77	31	62	39	308	701	223	177	262	4175	2704	1829	1094	285	77	2265	16719
	312	272	6086	374	8026	56	318	580	62	0	56	0	37	0	0	87	37	19	100	461	1235	636	112	150	56	1141
	315	827	1536	1183	1983	2920	483	190	228	57	439	33	0	0	0	0	1387	38	5721	2428	1895	1040	228	49	395	1161
	321	1189	2355	954	210	82	867	238	36	102	535	0	0	20	0	0	345	18	49	894	1161	55	98	82	16	229
	325	944	866	312	0	81	152	43	146	130	1066	455	14	0	0	0	103	108	16	752	2824	1526	65	16	1120	383
	326	166	99	0	50	0	69	80	0	34	69	0	46	0	0	194	11	0	11	52	109	57	0	0	0	0
	783 [1]	229	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	nf	nf	47	16	110	86	142	13	95	16	252
51-100	294 [5]	135	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	176	801	362	170	195	613	455	288	20685
	297 [5]	152	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	408	209	1892	7000	450	450	42	244	1317
	307	395	1943	380	4347	15450	3586	8803	5524	2717	797	869	353	2826	12769	1087	1645	1123	23490	5879	6991	5665	833	22912	9328	3172
	311	317	7907	1090	14968	3183	16905	17236	1599	2369	1134	218	145	392	2562	116	654	371	1652	2169	2864	610	780	349	2733	788
	317	193	8266	27	8190	4898	3487	2695	2363	226	1978	531	0	159	0	465	1195	451	173	305	1487	637	1049	372	199	1367
	319	984	16321	4826	338	9526	25403	17258	5888	8144	25764	2883	647	3023	150	575	11477	1889	15600	11839	9327	58696	34398	2149	26117	6064
	322	1587	8936	2694	10297	11946	9140	5030	7760	3745	5756	81	0	0	431	0	554	234	280	713	1529	413	633	263	649	2463
	323	696	3606	3878	6830	8866	10627	4040	2134	120	2011	16	0	0	0	0	82	24	32	158	1001	941	64	19	0	101
	324	494	8885	7203	38157	720	1087	2395	0	353	2633	163	0	0	544	85	91	272	160	361	442	85	306	391	85	432
	781 [1]	446	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	307	280	195	276	1058	716	1564	261	215	1052	568
	782 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	302	0	nf	63	38	38	315	76	227	50	63	221
101-150	295 [5]	209	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	168	465	976	615	978	144	187	72	976
	298 [5]	171	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	110	1861	46	3450	670	371	5399	976	282
	300 [5]	217	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	584	1579	641	896	791	746	1370	168	657
	306	363	2110	75	574	1071	3845	2422	1265	8273	982	1116	389	2659	1273	350	1106	816	771	708	4191	949	246	277	666	1015
	309	296	937	122	2484	4622	2443	3461	1771	3766	3122	244	95	1853	244	421	8190	280	11980	215	142	2056	13172	484	109	582
	310	170	133	94	203	351	304	836	6443	3414	13423	175	82	748	405	386	421	1380	105	131	187	505	485	1391	12	249
	313	165	68	23	238	0	409	136	2054	908	6866	2962	11	238	68	1124	182	0	454	91	113	3564	125	567	10	66
	316	189	240	117	78	28	78	87	1586	20669	3081	104		147	182	182	26	65	104	23	13	28	117	273	69	117
	318	129	8	0	874	27	710	18	4924	648	8955	5900	5051	2103	0	95656	630	1881	53	0	231	44	71	11943	275	683
	779 [1]	422	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	248	0	0	0	39	0	73	26	29	15	19	142
	780 [1]	403	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	0	nf	35	18	0	40	0	0	0	0	18
151-200	296 [5]	71	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	632	4	375	107	1924	735	303	2627	35
	299 [5]	212	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	643	49	0	13	131	160	214	44	29
	705	195	9	0	563	791	255	644	94	107	134	161	80	939	528	1113	418	241	376	24	54	83	241	232	267	64
	706	476	13	0	1097	557	9835	851	49	98	49	445	109	327	327	442	393	172	327	87	49	49	82	246	120	310
	707	74	3	0	836	560	753	1919	122	557	2682	1323	1817	494	219	448	2912	353	102	9	0	293	3079	143	121	1283
	715	128	158	44	3216	1638	643	3724	167	2509	20768	2386	309	1748	2249	414	4117	516	5874	484	751	3013	1615	960	102	305
	716	539	167	25	371	7656	2768	3470	704	593	1216	3979	463	204	519	578	1764	91	3089	2428	196	99	1333	952	74	142
201-300	708	126	0	0	2119	451	14317	14490	113	1410	537	1300	813	1621	15842	2808	208	388	1464	947	0	35	151	329	85	1419
	711	593	20	0	33	8227	392	387	218	544	9395	503	176	0	41	20	77	44	16	0	783	80	49	98	29	1530
	712	731	0	117	620	419	67	536	141	1931	1730	716	1098	302	369	322	101	60	201	50	98	117	67	345	60	15
	713	851	33	286	117	117	1463	368	843	20233	6951	1806	2819	234	1405	893	652	901	61	78	176	384	320	372	127	80
	714	1074	43	980	6701	835	396	905	4753	20966	32838	15431	12120	1440	2428	2996	750	2765	485	173	151	3781	1346	1678	230	77
301-400	709 [2]	147	0	0	0	0	nf	30	10	nf	40	nf	4556	1087	nf	101	0	nf	0	0	10	30	0	611	0	0
401-500	710 [1]	156	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	32	nf	nf	nf	nf	0	nf	nf	nf	nf	nf	nf
501-600	776 [1]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
601-700	777 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
701-800	778 [1]	166	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
	Total [3]		77,124	29,213	116,546	86,238	111,219	93,723	51,885	104,745	155,522	43,882	26,713	21,785	43,330	110,985	40,250	15,122	78,250	39,438	46,543	88,209	61,895	48,737	45,832	42,716
	Total [4]		77,124	29,213	116,546	86,238	111,219	93,753	51,895	104,745	155,562	43,882	31,269	22,872	43,912	111,393	40,530	18,290	83,997	45,537	60,428	95,405	65,775	57,813	51,776	70,748
	upper		107,186	53,111	618,003	126,503	169,378	152,888	79,714	177,819	240,890	64,676	49,856	29,586	72,419	1,325,521	64,189	21,365	166,891	55,196	60,749	147,318	119,231	109,897	95,755	171,310
	t-value		2.12	3.18	12.71	2.26	2.45	3.18	3.18	2.78	2.57	2.45	3.18	2.31	2.78	12.71	2.45	2.31	3.182	2.23	2.2	2.36	2.78	3.18	2.306	4.3
	std [6]		14,190	7,515	38,466	17,801	23,767	18,831	8,746	26,286	33,139	8,487	7,273	3,377	10,464	95,558	9,771	2,703	27,857	7,066	6,457	25,046	20,624	19,233	21,649	29,906

[1] These strata were added to the stratification scheme in 1994 (see Fig. 11 for stratum bondaries).

[2] Stratum 709 was redrawn in 1994 and includes stratum 710 from previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) fo: non-sampled strata .

[4] totals are for all strata fished .

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata.

Table 10. Cod biomass estimates (t) from DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps during 1983-2004. Shaded cells are model estimates. See Fig. 11 for location of strata.

																						Tel 351			Tel 522	AN 656
		Vessel	AN	AN	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT	WT
		Trips	9	26	26	45	55+56	68	81	91	103	118	133	135	150-151	165-167	186-187	202-203	219-220	236-237	313-315	364-365	418-419	476-477	523+546	617-618
Depth		Sets	164	93	109	136	130	148	146	108	158	137	136	130	166	161	148	158	176	175	171	173	177	176	177	178
range		Mean Da	30-Apr	13-Apr	13-Mar	15-Mar	7-Mar	5-Feb	9-Feb	9-Feb	10-Feb	14-Feb	13-Feb	11-Apr	15-Apr	16-Apr	22-Apr	12-Apr	21-Apr	24-Apr	21-Apr	18-Apr	15-Apr	22-Apr	24-Apr	27-Apr
(fathoms)	Strata	sq. mi	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
<30	314	974	16936	733	59	0	0	104	20	240	0	0	0	0	212	0	0	32	8	595	829	46	5	0	10	185
	320	1320	8914	8700	6971	464	700	2299	1893	0	267	52	0	0	0	0	155	114	7766	6287	6761	601	932	2707	395	1890
31-50	293 [5]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	17	19	27	45	26	9	29	18	1810
	306	112	1371	1157	1809	0	27	17	8	18	10	18	8	96	235	41	35	93	1461	1572	1088	184	48	12	1949	8011
	312	272	1179	1080	3691	110	102	25	14	0	23	0	28	0	0	13	4	13	8	226	640	93	10	9	18	345
	315	827	4143	2686	661	4606	1211	1992	2453	129	614	38	0	0	0	0	869	14	20072	3771	3092	491	822	17	335	13514
	321	1189	4121	1941	173	516	410	2201	506	24	146	0	0	37	0	0	8	2	0	1855	4582	2	5	2	2	40
	325	944	671	915	0	68	255	53	36	84	246	42	194	0	0	0	173	10	0	418	1307	340	10	3	568	84
	326	166	497	0	83	0	36	59	0	14	45	0	13	0	0	14	0	0	0	8	478	25	0	0	0	0
	783 [1]	229	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	nf	nf	0	0	14	15	6	0	2	1	303
51-100	294 [5]	135	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	24	40	19	7	26	47	22	14	21147
	297 [5]	152	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	39	22	1697	2339	108	38	6	42	1482
	307	395	2017	1441	8454	19930	4938	21706	6118	1033	171	126	70	1677	8984	250	633	332	16164	3784	5162	1578	197	26828	6055	2423
	311	317	5706	1711	10086	703	8576	2484	755	265	112	25	15	100	593	35	64	51	169	3342	1661	26	145	13	192	570
	317	193	7095	62	15799	3571	1867	352	496	18	756	73	0	244	0	40	73	62	196	36	259	331	88	59	78	218
	319	984	6983	6989	1861	16211	18530	23773	14172	2702	2436	382	82	507	32	208	12785	287	28144	18019	8121	51570	38958	755	67844	5845
	322	1567	9141	3904	2597	4571	3226	875	492	347	426	32	0	0	38	0	177	118	13	117	1893	193	32	26	38	1532
	323	696	1730	3935	2862	5790	21015	514	562	28	160	41	0	0	0	0	89	15	112	227	643	305	7	1	0	28
	324	494	1790	787	24660	521	384	455	0	38	217	33	0	0	7	18	3	11	8	252	26	7	14	13	8	148
	781 [1]	446	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	113	40	22	16	64	49	36	13	17	61	203
	782 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	8	0	nf	2	7	1	7	0	27	1	3	34
101-150	295 [5]	209	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	24	139	45	61	124	8	26	4	727
	298 [5]	171	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	42	2608	148	2632	202	75	2735	498	250
	300 [5]	217	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	147	802	650	307	153	124	175	103	391
	306	363	2167	448	974	2479	3315	4713	605	2786	149	484	114	1820	950	191	194	312	618	563	5123	543	67	51	960	812
	309	296	1690	292	3305	5739	4513	5255	3154	3062	1166	50	15	2021	359	272	4922	87	9788	320	303	1118	15666	193	56	464
	310	170	283	209	503	604	393	862	812	938	880	40	13	378	374	228	124	208	72	145	330	488	209	283	4	410
	313	165	158	242	481	0	563	155	1390	305	472	280	12	152	43	1279	259	0	481	162	97	18231	122	807	4	101
	316	189	492	262	151	113	144	59	3838	13956	294	43		144	270	42	38	40	138	43	21	63	78	146	103	95
	318	129	25	0	2438	146	1359	196	17756	668	2339	1600	1709	1616	0	129689	1075	404	88	0	592	28	43	12705	506	1672
	779 [1]	422	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	16	0	0	0	10	0	4	1	1	2	1	47
	780 [1]	403	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	0	0	nf	3	1	0	6	0	0	0	0	2
151-200	296 [5]	71	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	175	1	102	20	341	118	36	900	54
	299 [5]	212	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	282	231	0	1	411	655	315	35	15
	705	195	55	0	994	1063	273	1053	52	235	16	67	47	1143	652	1927	663	476	345	25	20	71	244	434	288	96
	706	476	72	0	3010	907	15334	1927	189	153	182	435	76	251	277	385	575	379	266	68	63	26	40	431	147	301
	707	74	11	0	1672	2779	1821	6883	411	459	1365	767	914	648	24	591	5408	72	121	21	0	360	3726	187	329	3347
	715	128	589	99	6482	2738	1315	7420	345	1061	17037	1928	347	1743	2802	575	3807	233	6849	1127	1240	5599	2525	1168	114	451
	716	539	311	24	710	7731	3291	4722	779	1112	386	952	64	226	676	777	1457	44	1772	4106	229	92	554	735	75	123
201-300	708	126	0	0	4448	690	18385	42342	123	1220	1072	2419	368	1081	10036	5511	247	629	4389	1455	0	54	139	354	78	1272
	711	593	26	0	62	10625	569	841	745	496	23174	380	290	0	30	27	82	43	11	0	1242	75	35	41	22	1864
	712	731	0	410	1267	644	262	1042	207	1419	1623	1020	1305	243	819	372	118	151	267	25	64	65	25	264	39	6
	713	851	61	1023	154	544	2469	567	1096	30722	6295	2025	3263	374	1700	1545	1481	1101	48	143	123	273	235	261	172	63
	714	1074	265	3788	16731	2749	473	1476	7310	30866	32946	18902	12987	1739	2528	4161	924	3471	725	155	123	4113	1212	2306	183	149
301-400	709 [2]	147	0	0	0	0	nf	118	52	nf	27	nf	2457	736	nf	121	0	nf	0	0	5	59	0	383	0	0
401-500	710 [1]	156	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	19	nf	nf	nf	nf	0	nf	nf	nf	nf	nf	nf
501-600	776 [1]	159	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
601-700	777 [1]	183	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
701-800	778 [1]	166	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf	nf
	Total [3]		77,499	42,838	123,054	96,611	115,746	136,422	66,327	94,398	94,925	32,214	21,934	16,240	31,641	148,191	36,442	8,802	100,100	48,857	46,111	86,991	66,193	50,811	80,560	46,059
	Total [4]		77,499	42,838	123,054	96,611	115,746	136,540	66,379	94,398	94,952	32,214	24,391	16,976	31,684	148,425	36,482	9,579	103,998	51,624	51,610	88,484	67,308	54,559	82,230	72,524
	upper		112,007	50,251	434,252	140,924	185,889	679,921	101,515	170,365	170,491	45,569	22,297	22,297	54,348	1,791,842	54,585	14,193	160,874	71,356	60,876	148,519	134,681	127,771	218,043	146,619
	t-value		2.20	2.06	12.71	2.26	2.45	12.71	2.31	2.31	2.57	2.26	2.13	2.31	2.78	12.71	2.23	2.36	2.201	2.13	2.15	2.57	2.78	3.18	2.365	3.18
	std [6]		15,678	3,599	24,492	10,608	28,630	42,752	15,259	32,943	29,403	5,909	170	2,622	8,168	129,320	8,143	2,284	27,612	10,563	6,067	23,941	24,636	24,201	56,132	31,623

[1] These strata were added to the stratification scheme in 1994.

[2] Strata 700 was redrawn in 1994 and includes the area covered by strata 710 in previous surveys. All sets done in 710 prior to 1994 have been recoded to 709.

[3] For index strata 0-300 fathoms in the offshore and includes estimates (shaded cells) for non-sampled strata .

[4] totals are for all strata fished .

[5] These strata were added to the stratification scheme in 1997.

[6] std's are for index strata and do not include estimates from non-sampled strata

Table 11A. Mean numbers per tow at age in Campelen units for the Canadian RV index for the period 1983 to 2005. Data are adjusted for missing strata. There were two surveys in 1993 (February and April). The 1997 and 1998 cohorts are shaded.

	Year																						
Age	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993F**	**1993A**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
											(Feb)	**(Apr)**												
1	6.42	0.30	0.38	0.20	1.09	0.42	0.49	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.90	0.22	**0.52**	**1.24**	1.25	0.57	0.58	0.52	0.20	0.77
2	10.01	5.40	7.74	6.62	8.48	9.13	6.50	1.48	27.69	1.80	0.00	0.00	1.63	0.31	1.08	1.53	0.97	**2.54**	**3.33**	2.26	1.10	1.46	1.90	1.43
3	6.52	2.33	14.88	5.65	5.67	5.93	4.66	9.82	5.03	6.95	1.83	1.99	1.46	1.16	3.67	2.33	6.79	2.55	**5.36**	**12.41**	3.90	1.78	2.07	6.73
4	1.14	1.55	12.57	6.48	4.97	2.96	3.17	14.49	10.00	2.11	4.03	4.04	4.31	1.67	3.62	1.04	8.42	2.38	3.10	**12.29**	**8.28**	4.08	1.71	4.96
5	3.72	0.63	9.96	7.95	13.82	2.84	1.51	10.89	11.24	4.15	0.71	1.49	6.10	13.08	1.32	0.50	5.60	2.58	2.17	4.36	**5.85**	**6.55**	2.08	1.60
6	1.62	2.11	3.28	6.33	8.31	6.50	1.16	5.67	5.75	2.03	2.96	1.35	1.73	19.65	2.69	0.28	3.99	2.34	1.82	2.04	3.04	**3.94**	**4.05**	0.89
7	0.48	0.77	2.66	2.13	3.35	5.84	2.15	3.84	2.84	1.03	0.68	0.47	1.62	4.40	2.91	0.30	1.96	1.72	1.20	1.26	2.04	1.50	**4.24**	**0.79**
8	0.89	0.37	0.79	1.47	1.29	3.65	1.21	3.14	1.58	0.53	0.33	0.10	0.50	5.75	0.54	0.24	2.50	0.44	0.89	0.77	0.99	0.72	1.26	**0.71**
9	1.61	0.46	0.48	0.84	0.69	1.49	0.67	1.15	1.19	0.26	0.13	0.04	0.08	2.19	0.46	0.14	2.79	0.79	0.35	0.71	0.53	0.33	0.81	0.28
10	0.75	0.71	0.42	0.29	0.28	0.84	0.37	0.71	0.74	0.24	0.09	0.03	0.04	0.25	0.09	0.05	0.43	0.60	0.31	0.38	0.37	0.18	0.67	0.05
11	0.36	0.18	0.42	0.24	0.23	0.74	0.41	0.32	0.56	0.08	0.11	0.04	0.03	0.20	0.09	0.02	0.30	0.09	0.53	0.50	0.08	0.19	0.79	0.17
12	0.14	0.15	0.49	0.29	0.16	0.35	0.13	0.16	0.22	0.04	0.03	0.01	0.02	0.01	0.02	0.00	0.06	0.02	0.12	0.94	0.12	0.05	0.15	0.08
13	0.06	0.06	0.21	0.17	0.17	0.16	0.11	0.12	0.11	0.01	0.04	0.00	0.01	0.07	0.00	0.00	0.03	0.02	0.00	0.12	0.19	0.11	0.10	0.03
14	0.05	0.03	0.12	0.10	0.16	0.15	0.05	0.09	0.07	0.01	0.01	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.01	0.06	0.01	0.01	0.02	0.03
15	0.04	0.00	0.03	0.06	0.06	0.09	0.09	0.01	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.01	0.07	0.09
16	0.04	0.04	0.03	0.04	0.04	0.10	0.06	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.15
17	0.01	0.00	0.05	0.02	0.05	0.01	0.04	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.02	0.03	0.02	0.00	0.04	0.01	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 11B. Mean numbers per tow at age in Campelen units for the Canadian research vessel bottom trawl survey of the western (Burgeo area) and eastern portions of NAFO Subdiv. 3Ps. Data are adjusted for missing strata. There were two surveys in 1993 (February and April). Only ages 1-14 are shown.

Western 3Ps (Burgeo area)

Age	1993A	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Age
1	0.00	0.00	0.00	0.42	0.00	**0.00**	**0.00**	0.41	0.04	0.16	0.08	0.00	0.00	1
2	0.00	0.00	0.49	1.37	0.60	0.42	**1.14**	**0.71**	6.05	0.83	1.94	1.68	2.74	2
3	3.37	4.84	2.60	10.48	2.94	26.74	4.50	**4.31**	**12.35**	6.61	4.25	6.22	21.17	3
4	8.04	9.73	2.75	12.50	4.73	25.99	6.24	6.56	**6.32**	**9.91**	16.66	6.14	20.84	4
5	6.44	15.76	2.26	4.87	1.83	28.22	10.27	6.52	4.07	**7.77**	**15.90**	8.89	5.41	5
6	6.94	8.60	3.03	5.84	1.66	18.46	3.61	7.81	4.35	8.86	**14.88**	**3.75**	2.42	6
7	1.73	6.26	1.32	6.11	1.02	13.65	3.90	6.20	4.20	6.97	5.65	**2.59**	**1.02**	7
8	0.53	2.89	2.07	1.17	0.92	6.28	0.50	1.95	1.73	3.09	3.06	0.73	**1.06**	8
9	0.21	0.51	0.58	1.50	0.72	2.43	0.78	0.95	1.22	1.37	1.95	0.66	0.30	9
10	0.09	0.16	0.08	0.03	0.11	0.40	0.20	0.08	0.96	0.92	1.23	0.46	0.08	10
11	0.15	0.08	0.06	0.17	0.05	2.10	0.23	0.00	0.21	0.32	1.89	0.48	0.00	11
12	0.00	0.06	0.05	0.00	0.00	0.00	0.38	0.15	0.10	0.15	0.26	0.15	0.00	12
13	0.01	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.03	0.11	0.58	0.03	0.00	13
14	0.01	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.15	0.00	14

Eastern 3Ps

Age	1993F	1993A	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Age
1	0.00	0.00	0.00	0.00	0.98	0.35	**0.60**	**1.67**	1.50	0.68	0.69	0.55	0.26	0.93	1
2	0.00	0.00	1.81	0.24	0.98	2.32	0.82	**2.68**	**4.25**	1.78	1.25	1.12	2.04	1.18	2
3	2.19	1.73	0.73	0.92	1.96	1.70	1.84	1.94	**5.26**	**14.31**	3.04	0.72	1.03	3.09	3
4	4.75	2.60	2.92	1.19	1.89	0.48	2.04	1.00	2.07	**12.75**	**7.93**	1.86	0.66	2.28	4
5	0.48	0.60	3.72	15.65	0.62	0.17	1.68	1.81	0.82	3.71	**5.30**	**4.47**	0.80	0.83	5
6	1.16	0.49	0.65	22.81	1.79	0.09	1.08	2.00	0.88	1.23	2.00	**1.66**	**4.56**	0.47	6
7	0.12	0.28	0.73	2.93	2.38	0.14	0.64	1.34	0.52	0.63	1.13	0.20	**5.87**	**0.80**	7
8	0.08	0.05	0.17	3.60	0.35	0.11	2.50	0.35	0.62	0.52	0.61	0.05	1.67	**0.57**	8
9	0.05	0.01	0.01	2.27	0.16	0.04	2.91	0.83	0.26	0.59	0.35	0.09	0.17	0.22	9
10	0.01	0.00	0.03	0.29	0.10	0.02	0.27	0.69	0.39	0.13	0.26	0.01	0.39	0.03	10
11	0.01	0.01	0.01	0.23	0.07	0.01	0.07	0.04	0.64	0.54	0.01	0.00	0.23	0.19	11
12	0.03	0.00	0.01	0.00	0.02	0.00	0.04	0.02	0.10	1.21	0.10	0.01	0.03	0.09	12
13	0.01	0.00	0.01	0.07	0.00	0.00	0.00	0.03	0.00	0.09	0.16	0.02	0.00	0.04	13
14	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.06	0.02	0.01	0.03	0.04	14

Table 11B. Mean numbers per tow at age in Campelen units for the Canadian research vessel bottom trawl survey of the western (Burgeo area) and eastern portions of NAFO Subdiv. 3Ps. Data are adjusted for missing strata. There were two surveys in 1993 (February and April). Only ages 1-14 are shown.

Western 3Ps (Burgeo area)

Age	1993A	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Age
1	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.41	0.04	0.16	0.08	0.00	0.00	1
2	0.00	0.00	0.49	1.37	0.60	0.42	1.14	0.71	6.05	0.83	1.94	1.68	2.74	2
3	3.37	4.84	2.60	10.48	2.94	26.74	4.50	4.31	12.35	6.61	4.25	6.22	21.17	3
4	8.04	9.73	2.75	12.50	4.73	25.99	6.24	6.56	6.32	9.91	16.66	6.14	20.84	4
5	6.44	15.76	2.26	4.87	1.83	28.22	10.27	6.52	4.07	7.77	15.90	8.89	5.41	5
6	6.94	8.60	3.03	5.84	1.66	18.46	3.61	7.81	4.35	8.86	14.88	3.75	2.42	6
7	1.73	6.26	1.32	6.11	1.02	13.65	3.90	6.20	4.20	6.97	5.65	2.59	1.02	7
8	0.53	2.89	2.07	1.17	0.92	6.28	0.50	1.95	1.73	3.09	3.06	0.73	1.06	8
9	0.21	0.51	0.58	1.50	0.72	2.43	0.78	0.95	1.22	1.37	1.95	0.66	0.30	9
10	0.09	0.16	0.08	0.03	0.11	0.40	0.20	0.08	0.96	0.92	1.23	0.46	0.08	10
11	0.15	0.08	0.06	0.17	0.05	2.10	0.23	0.00	0.21	0.32	1.89	0.48	0.00	11
12	0.00	0.06	0.05	0.00	0.00	0.00	0.38	0.15	0.10	0.15	0.26	0.15	0.00	12
13	0.01	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.03	0.11	0.58	0.03	0.00	13
14	0.01	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.15	0.00	14

Eastern 3Ps

Age	1993F	1993A	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Age
1	0.00	0.00	0.00	0.00	0.98	0.35	0.60	1.67	1.50	0.68	0.69	0.55	0.26	0.93	1
2	0.00	0.00	1.81	0.24	0.98	2.32	0.82	2.68	4.25	1.78	1.25	1.12	2.04	1.18	2
3	2.19	1.73	0.73	0.92	1.96	1.70	1.84	1.94	5.26	14.31	3.04	0.72	1.03	3.09	3
4	4.75	2.60	2.92	1.19	1.89	0.48	2.04	1.00	2.07	12.75	7.93	1.86	0.66	2.28	4
5	0.48	0.60	3.72	15.65	0.62	0.17	1.68	1.81	0.82	3.71	5.30	4.47	0.80	0.83	5
6	1.16	0.49	0.65	22.81	1.79	0.09	1.08	2.00	0.88	1.23	2.00	1.66	4.56	0.47	6
7	0.12	0.28	0.73	2.93	2.38	0.14	0.64	1.34	0.52	0.63	1.13	0.20	5.87	0.80	7
8	0.08	0.05	0.17	3.60	0.35	0.11	2.50	0.35	0.62	0.52	0.61	0.05	1.67	0.57	8
9	0.05	0.01	0.01	2.27	0.16	0.04	2.91	0.83	0.26	0.59	0.35	0.09	0.17	0.22	9
10	0.01	0.00	0.03	0.29	0.10	0.02	0.27	0.69	0.39	0.13	0.26	0.01	0.39	0.03	10
11	0.01	0.01	0.01	0.23	0.07	0.01	0.07	0.04	0.64	0.54	0.01	0.00	0.23	0.19	11
12	0.03	0.00	0.01	0.00	0.02	0.00	0.04	0.02	0.10	1.21	0.10	0.01	0.03	0.09	12
13	0.01	0.00	0.01	0.07	0.00	0.00	0.00	0.03	0.00	0.09	0.16	0.02	0.00	0.04	13
14	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.06	0.02	0.01	0.03	0.04	14

Table 12. Mean length-at-age (cm) of cod sampled during research bottom-trawl surveys in Subdivision 3Ps in winter-spring 1972-2005. Entries in boxes are based on fewer than 5 aged fish

Age	1972	1973	1974	1975	1976	1977
1	14.0	11.6	12.2	12.7	13.2	11.0
2	23.2	22.6	21.7	23.1	22.8	20.3
3	31.5	31.7	33.4	35.3	35.4	31.7
4	41.0	39.3	43.1	44.4	48.2	43.2
5	51.9	50.1	50.8	55.4	57.4	55.6
6	58.5	56.6	55.6	61.0	64.6	63.5
7	63.0	62.1	63.6	66.5	68.1	73.9
8	74.1	66.1	71.2	74.3	71.6	75.2
9	81.8	68.4	69.3	74.2	78.5	88.0
10	90.4	81.1	79.0	75.2	81.6	83.8
11	95.0	88.2	93.3	76.2	94.8	77.6
12	88.3	87.1	95.6	107.2	110.5	87.9

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1		10.8	14.6	14.6	13.2	10.3	12.0		11.0	10.7	9.2	12.0		9.5				
2	19.6	22.1	21.0	22.4	22.0	20.2	19.2	17.9	18.7	19.9	19.7	19.2	20.0	19.2	20.7		19.1	21.2
3	28.0	32.2	28.1	32.4	33.3	31.2	30.6	29.0	26.8	29.5	29.0	30.1	29.9	29.5	30.5	30.9	32.3	30.1
4	35.9	42.6	42.9	44.4	44.9	43.0	42.1	40.3	40.3	39.4	40.8	41.6	40.0	38.5	40.9	41.1	39.2	41.4
5	48.0	47.4	50.6	50.6	53.4	52.6	51.8	50.9	48.6	48.1	47.5	47.9	48.0	46.9	47.1	48.0	48.0	50.3
6	59.0	56.3	58.2	58.6	59.3	57.8	60.6	60.0	55.5	53.9	56.2	56.0	53.7	53.3	55.1	52.6	50.2	56.4
7	65.6	70.5	71.3	63.2	66.4	65.4	66.2	66.3	62.1	61.1	61.9	63.9	56.6	57.4	61.1	62.2	53.6	58.2
8	70.1	76.8	84.8	69.9	70.1	71.4	70.6	74.0	72.1	67.3	66.7	71.8	62.2	62.7	62.4	70.3	59.1	57.9
9	84.1	85.8	94.9	72.6	75.6	73.3	75.6	74.3	76.4	77.8	74.6	75.9	70.1	68.1	66.6	77.1	68.0	63.0
10	86.3	95.3	98.0	83.2	90.6	79.4	78.9	79.3	82.6	85.4	79.7	84.4	76.1	73.7	73.4	80.5	88.0	79.8
11	88.3	94.3	97.2	97.6	98.7	89.6	84.1	89.1	93.3	83.1	79.7	88.5	79.4	73.8	83.6	96.0	79.3	81.2
12	79.3	116.0	106.6	90.1	104.6	94.1	98.2	93.0	93.8	89.9	87.5	96.5	88.7	77.2	81.8	106.0	90.3	83.6

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	12.6	12.7	10.6	12.0	13.3	10.6	12.0	10.7	14.0	12.1
2	20.6	24.1	22.3	22.2	22.0	21.9	22.0	23.7	20.1	25.5
3	30.0	31.7	32.5	31.4	31.7	33.3	31.7	31.8	33.7	34.2
4	38.6	40.8	42.5	42.9	40.7	40.7	42.1	42.8	38.9	41.7
5	44.0	47.9	48.7	51.2	48.6	47.3	50.5	51.6	47.6	48.4
6	52.9	51.5	53.2	58.9	54.6	51.8	54.9	55.3	60.9	54.4
7	60.9	60.6	57.5	61.7	60.3	57.3	55.2	58.6	66.0	63.4
8	61.1	65.2	67.0	66.2	65.3	68.4	67.2	58.5	69.1	67.7
9	63.3	66.9	77.2	77.6	67.8	78.2	74.5	70.5	67.2	72.2
10	76.7	67.3	77.2	86.5	81.1	75.8	79.7	72.2	69.7	72.6
11	74.7	82.5	64.3	76.9	92.5	89.0	73.4	65.5	73.1	99.7
12	86.1		78.0	109.0	89.1	96.2	86.0	86.4	73.2	102.72

Table 13. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in Subdiv. 3Ps in winter-spring 1978-2005. Entries in boxes are based on fewer than 5 aged fish.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1		0.011	0.027		0.040	0.010								0.012				
2	0.057	0.070	0.068	0.060	0.103	0.068	0.073		0.045		0.057	0.060	0.062	0.054	0.064		0.053	0.062
3	0.177	0.258	0.147	0.265	0.420	0.232	0.268	0.214	0.168	0.248	0.193	0.239	0.208	0.217	0.230	0.220	0.254	0.212
4	0.396	0.633	0.618	0.704	0.829	0.718	0.632	0.505	0.462	0.538	0.582	0.613	0.538	0.465	0.574	0.550	0.460	0.540
5	0.979	0.879	1.005	1.079	1.299	1.301	1.212	1.039	0.905	0.950	0.915	0.901	0.954	0.865	0.865	0.894	0.898	1.017
6	1.735	1.565	1.634	1.673	1.539	1.652	1.853	1.566	1.332	1.273	1.494	1.331	1.348	1.324	1.461	1.150	1.044	1.514
7	2.368	3.029	3.457	2.081	2.555	1.861	2.790	2.279	2.384	1.885	2.214	2.361	1.621	1.702	2.032	1.987	1.236	1.687
8	3.192	5.666	5.791	3.496	2.612	3.555	3.828	3.206	3.337	2.297	2.423	3.778	2.185	2.346	2.258	3.003	1.814	1.585
9	4.676	5.798	8.459	4.890	4.007	4.042	4.225	3.143	5.023	4.483	3.943	4.505	3.060	3.087	2.859	4.281	2.891	2.209
10	5.711	7.108	8.333	7.591	6.441	4.896	5.029	3.760	4.654	6.344	4.839	5.820	4.225	3.956	3.983	4.470	6.450	4.767
11	4.901	9.030	9.085	8.374	8.885	8.848	7.866		6.633	6.616	4.262	8.285	4.934	4.050	5.796	8.673	4.470	5.446
12	5.760		10.158	11.463	13.068	10.270	9.818	3.970	8.867	5.945	9.103	9.061	7.365	4.906	5.240	13.200	6.748	5.544

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	0.018	0.016	0.011	0.014	0.018	0.012	0.015	0.014	0.023	0.016
2	0.072	0.108	0.091	0.095	0.087	0.086	0.087	0.108	0.070	0.145
3	0.218	0.257	0.282	0.286	0.272	0.293	0.258	0.266	0.324	0.344
4	0.461	0.552	0.659	0.646	0.562	0.545	0.595	0.638	0.483	0.605
5	0.673	0.878	0.941	1.130	0.953	0.819	1.031	1.130	0.868	0.935
6	1.283	1.076	1.274	1.709	1.333	1.204	1.367	1.434	1.951	1.418
7	2.009	1.904	1.640	1.992	1.902	1.668	1.357	1.780	2.478	2.286
8	2.084	2.608	2.791	2.549	2.376	2.999	2.839	1.715	2.991	3.020
9	2.136	2.867	4.660	4.565	2.904	4.453	4.027	2.952	2.767	4.002
10	4.464	3.083	4.441	6.567	5.437	4.402	4.844	3.926	3.317	4.618
11	3.897	5.456	2.528	4.265	8.351	6.949	3.576	2.470	3.906	10.785
12	6.793		4.190	12.388	6.780	8.805	6.031	5.988	4.1973	11.453

Table 14. Mean gutted condition-at-age of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in winter-spring 1978-2005. Boxed entries are based on fewer than 5 aged fish.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1																		
2	0.702	0.629	0.595	0.599	0.660	0.632	0.651		0.699		0.644	0.681	0.623	0.641	0.598		0.627	0.630
3	0.745	0.678	0.620	0.718	0.731	0.742	0.734	0.706	0.698	0.736	0.713	0.725	0.680	0.706	0.711	0.657	0.675	0.687
4	0.733	0.715	0.680	0.748	0.740	0.777	0.735	0.704	0.704	0.725	0.739	0.739	0.726	0.710	0.732	0.711	0.677	0.690
5	0.753	0.702	0.703	0.724	0.722	0.766	0.703	0.680	0.733	0.735	0.731	0.734	0.744	0.720	0.716	0.700	0.705	0.702
6	0.730	0.712	0.709	0.745	0.676	0.794	0.711	0.714	0.709	0.717	0.731	0.741	0.743	0.746	0.733	0.663	0.680	0.708
7	0.744	0.699	0.724	0.729	0.699	0.737	0.728	0.739	0.721	0.735	0.736	0.748	0.735	0.741	0.735	0.677	0.660	0.703
8	0.716	0.775	0.734	0.763	0.690	0.725	0.726	0.714	0.717	0.720	0.736	0.780	0.726	0.738	0.727	0.698	0.676	0.665
9	0.737	0.749	0.765	0.748	0.731	0.744	0.730	0.733	0.676	0.768	0.777	0.793	0.735	0.753	0.738	0.758	0.687	0.701
10	0.793	0.803	0.715	0.810	0.751	0.793	0.741	0.740	0.719	0.770	0.789	0.834	0.764	0.777	0.732	0.684	0.732	0.725
11	0.681	0.648	0.784	0.790	0.758	0.819	0.808		0.798	0.779	0.783	0.827	0.794	0.765	0.766	0.786	0.691	0.750
12	0.725		0.759	0.843	0.833	0.865	0.834	0.681	0.789	0.774	0.813	0.852	0.793	0.794	0.744	0.852	0.717	0.753

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	0.754	0.727	0.898	0.673	0.594	0.963	0.638	0.876	0.684	0.768
2	0.697	0.674	0.660	0.675	0.666	0.665	0.680	0.671	0.675	0.707
3	0.706	0.717	0.699	0.704	0.696	0.684	0.694	0.700	0.716	0.730
4	0.709	0.725	0.720	0.697	0.707	0.686	0.688	0.702	0.707	0.722
5	0.695	0.702	0.704	0.694	0.688	0.680	0.676	0.703	0.677	0.708
6	0.713	0.683	0.680	0.688	0.677	0.722	0.690	0.697	0.705	0.709
7	0.715	0.693	0.689	0.690	0.674	0.659	0.666	0.701	0.705	0.731
8	0.722	0.714	0.725	0.686	0.674	0.699	0.712	0.674	0.715	0.730
9	0.671	0.713	0.757	0.722	0.698	0.702	0.728	0.674	0.720	0.752
10	0.758	0.751	0.742	0.762	0.754	0.695	0.740	0.649	0.730	0.752
11	0.725	0.785	0.748	0.722	0.784	0.732	0.669	0.669	0.710	0.806
12	0.760		0.784	0.737	0.712	0.773	0.734	0.712	0.734	0.810

Table 15. Mean liver index at age of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in winter-spring 1978-2004. Boxed entries are based on fewer than 5 aged fish.

Age	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1																		
2	0.0175	0.0142	0.0150	0.0118	0.0229	0.0247	0.0120	0.0236	0.0230	0.0304	0.0250	0.0279	0.0292	0.0250	0.0301		0.0304	0.0139
3	0.0223	0.0160	0.0114	0.0146	0.0244	0.0280	0.0167	0.0168	0.0233	0.0233	0.0227	0.0216	0.0213	0.0213	0.0200	0.0106	0.0144	0.0111
4	0.0203	0.0181	0.0143	0.0188	0.0228	0.0323	0.0179	0.0175	0.0196	0.0225	0.0275	0.0266	0.0293	0.0280	0.0242	0.0154	0.0138	0.0131
5	0.0227	0.0194	0.0189	0.0169	0.0230	0.0275	0.0142	0.0176	0.0214	0.0240	0.0281	0.0269	0.0335	0.0287	0.0315	0.0180	0.0197	0.0209
6	0.0253	0.0218	0.0204	0.0194	0.0163	0.0348	0.0144	0.0217	0.0230	0.0241	0.0280	0.0300	0.0357	0.0309	0.0309	0.0187	0.0221	0.0201
7	0.0256	0.0293	0.0262	0.0213	0.0207	0.0277	0.0195	0.0217	0.0237	0.0273	0.0279	0.0303	0.0376	0.0362	0.0263	0.0184	0.0170	0.0211
8	0.0323	0.0359	0.0370	0.0322	0.0203	0.0303	0.0191	0.0233	0.0268	0.0291	0.0312	0.0341	0.0334	0.0337	0.0368	0.0206	0.0211	0.0179
9	0.0284	0.0319	0.0381	0.0418	0.0225	0.0326	0.0188	0.0268	0.0303	0.0362	0.0357	0.0412	0.0349	0.0386	0.0400	0.0280	0.0208	0.0189
10	0.0326	0.0362	0.0328	0.0470	0.0258	0.0327	0.0328	0.0301	0.0383	0.0462	0.0439	0.0432	0.0411	0.0410	0.0379	0.0182	0.0423	0.0265
11	0.0256	0.0276	0.0381	0.0277	0.0356	0.0445	0.0330	0.0405	0.0435	0.0404	0.0495	0.0519	0.0471	0.0419	0.0473	0.0346	0.0232	0.0343
12	0.0379		0.0385	0.0415	0.0539	0.0462	0.0451	0.0435	0.0463	0.0482	0.0545	0.0689	0.0477	0.0373	0.0376	0.0379	0.0326	0.0247

Age	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1										
2	0.0252	0.0244	0.0247	0.0239	0.0241	0.0231	0.0235	0.0242	0.0242	0.0224
3	0.0160	0.0208	0.0165	0.0205	0.0181	0.0145	0.0193	0.0214	0.0188	0.0222
4	0.0161	0.0199	0.0206	0.0170	0.0152	0.0163	0.0155	0.0199	0.0156	0.0223
5	0.0168	0.0201	0.0216	0.0167	0.0193	0.0158	0.0176	0.0210	0.0176	0.0244
6	0.0201	0.0183	0.0249	0.0168	0.0191	0.0207	0.0203	0.0231	0.0259	0.0247
7	0.0219	0.0230	0.0227	0.0210	0.0210	0.0171	0.0172	0.0265	0.0241	0.0272
8	0.0231	0.0240	0.0346	0.0197	0.0222	0.0228	0.0198	0.0197	0.0217	0.0280
9	0.0194	0.0273	0.0407	0.0294	0.0235	0.0266	0.0242	0.0310	0.0204	0.0314
10	0.0303	0.0379	0.0424	0.0388	0.0342	0.0262	0.0271	0.0228	0.0222	0.0297
11	0.0314	0.0396	0.0271	0.0234	0.0385	0.0288	0.0110	0.0225	0.0261	0.0554
12	0.0202		0.0284	0.0260	0.0298	0.0345	0.0259	0.0334	0.0208	0.0530

Table 16. Parameter estimates and SE's for a probit model fitted to observed proportions mature at age for female cod from NAFO Subdiv. 3Ps based on surveys conducted during 1972-2005 (nf=no significant model fit). Estimates are given only for cohorts with a significant slope and intercept term.

Cohort	slope	slope_SE	intercept	intercept_se
1954	1.109	0.294	-8.170	2.444
1955	1.506	0.224	-10.263	1.612
1956	1.317	0.321	-9.459	2.222
1957	1.460	0.370	-10.325	2.353
1958	2.393	0.585	-16.452	3.620
1959	2.111	0.536	-13.020	2.936
1960	1.674	0.299	-10.668	1.758
1961	1.864	0.355	-11.472	2.067
1962	1.714	0.290	-10.512	1.704
1963	.	.	.	.
1964	1.927	0.241	-12.718	1.567
1965	2.419	0.598	-16.424	4.239
1966	1.549	0.240	-10.061	1.602
1967	1.688	0.378	-10.084	2.254
1968	2.140	0.289	-13.163	1.787
1969	1.683	0.304	-10.367	1.844
1970	1.526	0.231	-8.856	1.314
1971	1.312	0.140	-7.841	0.835
1972	1.412	0.145	-8.908	0.885
1973	1.452	0.167	-9.355	1.032
1974	2.004	0.197	-13.154	1.294
1975	1.785	0.217	-11.164	1.376
1976	1.355	0.206	-8.599	1.251
1977	2.507	0.350	-15.364	2.173
1978	1.792	0.168	-10.732	1.020
1979	1.030	0.114	-6.448	0.767
1980	1.427	0.141	-9.413	0.913
1981	1.743	0.178	-11.987	1.185
1982	2.009	0.206	-13.306	1.350
1983	1.894	0.261	-11.890	1.604
1984	2.232	0.298	-13.417	1.804
1985	2.699	0.373	-16.034	2.201
1986	2.583	0.293	-14.067	1.593
1987	2.253	0.223	-11.923	1.235
1988	2.773	0.411	-14.021	2.167
1989	1.884	0.158	-9.783	0.811
1990	1.787	0.190	-9.202	0.959
1991	3.548	1.040	-18.346	5.226
1992	2.333	0.359	-11.876	1.770
1993	1.817	0.244	-9.552	1.352
1994	1.470	0.206	-7.632	1.083
1995	1.540	0.242	-8.639	1.348
1996	1.761	0.289	-9.621	1.570
1997	2.786	0.462	-13.385	2.218
1998	2.253	0.313	-10.582	1.483
1999	1.533	0.293	-7.622	1.420
2000	1.872	0.710	-10.189	3.338

Table 17. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1972 to 2005 projected forward to 2010. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age. Darkly shaded cells are averages of the three closest cohorts; boxed cells are the average of estimates for the adjacent cohorts.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1954	0.0004	0.0015	0.0050	0.0175	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1955	0.0009	0.0015	0.0050	0.0175	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1956	0.0002	0.0026	0.0050	0.0175	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1957	0.0003	0.0007	0.0078	0.0175	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1958	0.0001	0.0011	0.0032	0.0233	0.0607	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1959	0.0000	0.0006	0.0040	0.0142	0.0675	0.1936	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1960	0.0000	0.0000	0.0026	0.0149	0.0611	0.1801	0.4697	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1961	0.0001	0.0002	0.0001	0.0112	0.0535	0.2267	0.3996	0.7570	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1962	0.0001	0.0007	0.0012	0.0010	0.0463	0.1741	0.5693	0.6686	0.9133	0.9723	0.9914	0.9973	0.9992	0.9997
1963	0.0002	0.0004	0.0035	0.0102	0.0111	0.1729	0.4403	0.8563	0.8595	0.9723	0.9914	0.9973	0.9992	0.9997
1964	0.0001	0.0008	0.0028	0.0185	0.0783	0.1097	0.4738	0.7459	0.9641	0.9488	0.9914	0.9973	0.9992	0.9997
1965	0.0000	0.0005	0.0046	0.0177	0.0913	0.4124	0.5742	0.7949	0.9164	0.9918	0.9825	0.9973	0.9992	0.9997
1966	0.0000	0.0001	0.0028	0.0252	0.1041	0.3489	0.8528	0.9366	0.9435	0.9761	0.9982	0.9942	0.9992	0.9997
1967	0.0002	0.0000	0.0010	0.0159	0.1254	0.4285	0.7408	0.9795	0.9938	0.9863	0.9935	0.9996	0.9981	0.9997
1968	0.0002	0.0009	0.0001	0.0066	0.0846	0.4432	0.8286	0.9384	0.9975	0.9994	0.9968	0.9982	0.9999	0.9994
1969	0.0000	0.0012	0.0044	0.0012	0.0438	0.3413	0.8155	0.9689	0.9878	0.9997	0.9999	0.9993	0.9995	1.0000
1970	0.0002	0.0001	0.0066	0.0205	0.0130	0.2394	0.7496	0.9608	0.9951	0.9977	1.0000	1.0000	0.9998	0.9999
1971	0.0007	0.0009	0.0012	0.0345	0.0898	0.1290	0.6837	0.9489	0.9927	0.9992	0.9996	1.0000	1.0000	1.0000
1972	0.0015	0.0030	0.0049	0.0099	0.1619	0.3171	0.6246	0.9369	0.9915	0.9987	0.9999	0.9999	1.0000	1.0000
1973	0.0006	0.0054	0.0137	0.0257	0.0785	0.5110	0.6861	0.9492	0.9903	0.9986	0.9998	1.0000	1.0000	1.0000
1974	0.0004	0.0023	0.0197	0.0600	0.1243	0.4199	0.8497	0.9114	0.9953	0.9986	0.9998	1.0000	1.0000	1.0000
1975	0.0000	0.0016	0.0093	0.0696	0.2269	0.4332	0.8602	0.9683	0.9798	0.9996	0.9998	1.0000	1.0000	1.0000
1976	0.0001	0.0001	0.0067	0.0370	0.2174	0.5744	0.8044	0.9812	0.9940	0.9956	1.0000	1.0000	1.0000	1.0000
1977	0.0007	0.0005	0.0008	0.0280	0.1361	0.5077	0.8613	0.9568	0.9978	0.9989	0.9991	1.0000	1.0000	1.0000
1978	0.0000	0.0028	0.0030	0.0058	0.1096	0.3927	0.7930	0.9662	0.9917	0.9997	0.9998	0.9998	1.0000	1.0000
1979	0.0001	0.0000	0.0106	0.0176	0.0417	0.3446	0.7263	0.9343	0.9924	0.9984	1.0000	1.0000	1.0000	1.0000
1980	0.0044	0.0008	0.0004	0.0400	0.0963	0.2442	0.6919	0.9159	0.9814	0.9983	0.9997	1.0000	1.0000	1.0000
1981	0.0003	0.0123	0.0047	0.0048	0.1390	0.3884	0.7056	0.9056	0.9781	0.9949	0.9996	0.9999	1.0000	1.0000
1982	0.0000	0.0014	0.0336	0.0275	0.0558	0.3849	0.7910	0.9467	0.9762	0.9946	0.9986	0.9999	1.0000	1.0000
1983	0.0000	0.0002	0.0059	0.0888	0.1453	0.4202	0.7081	0.9575	0.9925	0.9943	0.9987	0.9996	1.0000	1.0000
1984	0.0000	0.0001	0.0012	0.0240	0.2145	0.5050	0.8989	0.9039	0.9926	0.9990	0.9987	0.9997	0.9999	1.0000
1985	0.0000	0.0003	0.0007	0.0066	0.0930	0.4334	0.8596	0.9909	0.9733	0.9988	0.9999	0.9997	0.9999	1.0000
1986	0.0000	0.0001	0.0020	0.0051	0.0365	0.2992	0.6818	0.9735	0.9993	0.9930	0.9998	1.0000	0.9999	1.0000
1987	0.0000	0.0000	0.0012	0.0132	0.0369	0.1781	0.6401	0.8572	0.9955	0.9999	0.9982	1.0000	1.0000	1.0000
1988	0.0001	0.0001	0.0004	0.0111	0.0817	0.2224	0.5533	0.8811	0.9439	0.9992	1.0000	0.9995	1.0000	1.0000
1989	0.0000	0.0006	0.0018	0.0053	0.0947	0.3715	0.6807	0.8762	0.9686	0.9792	0.9999	1.0000	0.9999	1.0000
1990	0.0004	0.0002	0.0057	0.0233	0.0732	0.4938	0.7971	0.9408	0.9759	0.9923	0.9925	1.0000	1.0000	1.0000
1991	0.0006	0.0024	0.0033	0.0516	0.2401	0.5399	0.9009	0.9631	0.9916	0.9957	0.9981	0.9973	1.0000	1.0000
1992	0.0000	0.0036	0.0158	0.0507	0.3412	0.8071	0.9458	0.9883	0.9943	0.9989	0.9992	0.9996	0.9990	1.0000
1993	0.0001	0.0000	0.0210	0.0956	0.4611	0.8313	0.9823	0.9962	0.9987	0.9991	0.9998	0.9999	0.9999	0.9997
1994	0.0004	0.0007	0.0005	0.1136	0.4102	0.9319	0.9791	0.9986	0.9997	0.9999	0.9999	1.0000	1.0000	1.0000
1995	0.0021	0.0027	0.0076	0.0155	0.4336	0.8207	0.9955	0.9978	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1996	0.0008	0.0091	0.0163	0.0728	0.3530	0.8205	0.9679	0.9997	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1997	0.0004	0.0038	0.0383	0.0925	0.4474	0.9499	0.9647	0.9950	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1998	0.0000	0.0022	0.0177	0.1478	0.3853	0.8930	0.9985	0.9939	0.9992	1.0000	1.0000	1.0000	1.0000	1.0000
1999	0.0002	0.0004	0.0129	0.0773	0.4300	0.7941	0.9885	1.0000	0.9990	0.9999	1.0000	1.0000	1.0000	1.0000
2000	0.0023	0.0023	0.0065	0.0706	0.2811	0.7664	0.9596	0.9989	1.0000	0.9998	1.0000	1.0000	1.0000	1.0000
2001	0.0002	0.0104	0.0214	0.0961	0.3066	0.6459	0.9345	0.9932	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
2002	0.0009	0.0016	0.0464	0.1722	0.6330	0.7201	0.8948	0.9841	0.9989	1.0000	1.0000	1.0000	1.0000	1.0000
2003	0.0009	0.0048	0.0102	0.1839	0.6644	0.9655	0.9374	0.9754	0.9963	0.9998	1.0000	1.0000	1.0000	1.0000
2004	0.0009	0.0048	0.0260	0.0629	0.5107	0.9496	0.9978	0.9886	0.9946	0.9991	1.0000	1.0000	1.0000	1.0000
2005	0.0009	0.0048	0.0260	0.1397	0.3039	0.8286	0.9945	0.9999	0.9980	0.9988	0.9998	1.0000	1.0000	1.0000
2006	0.0009	0.0048	0.0260	0.1397	0.4930	0.7394	0.9573	0.9994	1.0000	0.9997	0.9998	1.0000	1.0000	1.0000
2007	0.0009	0.0048	0.0260	0.1397	0.4930	0.8392	0.9486	0.9905	0.9999	1.0000	0.9999	0.9999	1.0000	1.0000
2008	0.0009	0.0048	0.0260	0.1397	0.4930	0.8392	0.9668	0.9917	0.9979	1.0000	1.0000	1.0000	1.0000	1.0000
2009	0.0009	0.0048	0.0260	0.1397	0.4930	0.8392	0.9668	0.9939	0.9987	0.9996	1.0000	1.0000	1.0000	1.0000

Table 17. Estimated proportions mature for female cod from NAFO Subdiv. 3Ps from DFO surveys from 1972 to 2005 projected forward to 2010. Estimates were obtained from a probit model fitted by cohort to observed proportions mature at age. Darkly shaded cells are averages of the three closest cohorts; boxed cells are the average of estimates for the adjacent cohorts.

Year/Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1954	**0.0004**	**0.0015**	**0.0050**	**0.0175**	**0.0607**	**0.1936**	**0.4697**	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1955	0.0009	**0.0015**	**0.0050**	**0.0175**	**0.0607**	**0.1936**	**0.4697**	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1956	0.0002	0.0026	**0.0050**	**0.0175**	**0.0607**	**0.1936**	**0.4697**	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1957	0.0003	0.0007	0.0078	**0.0175**	**0.0607**	**0.1936**	**0.4697**	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1958	0.0001	0.0011	0.0032	0.0233	**0.0607**	**0.1936**	**0.4697**	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1959	0.0000	0.0006	0.0040	0.0142	0.0675	**0.1936**	**0.4697**	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1960	0.0000	0.0000	0.0026	0.0149	0.0611	0.1801	**0.4697**	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1961	0.0001	0.0002	0.0001	0.0112	0.0535	0.2267	0.3996	**0.7570**	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1962	0.0001	0.0007	0.0012	0.0010	0.0463	0.1741	0.5693	0.6686	**0.9133**	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1963	0.0002	0.0004	0.0035	0.0102	0.0111	0.1729	0.4403	0.8563	0.8595	**0.9723**	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1964	0.0001	0.0008	0.0028	0.0185	0.0783	0.1097	0.4738	0.7459	0.9641	0.9488	**0.9914**	**0.9973**	**0.9992**	**0.9997**
1965	0.0000	0.0005	0.0046	0.0177	0.0913	0.4124	0.5742	0.7949	0.9164	0.9918	0.9825	**0.9973**	**0.9992**	**0.9997**
1966	0.0000	0.0001	0.0028	0.0252	0.1041	0.3489	0.8528	0.9366	0.9435	0.9761	0.9982	0.9942	**0.9992**	**0.9997**
1967	0.0002	0.0000	0.0010	0.0159	0.1254	0.4285	0.7408	0.9795	0.9938	0.9863	0.9935	0.9996	0.9981	**0.9997**
1968	0.0002	0.0009	0.0001	0.0066	0.0846	0.4432	0.8286	0.9384	0.9975	0.9994	0.9968	0.9982	0.9999	0.9994
1969	0.0000	0.0012	0.0044	0.0012	0.0438	0.3413	0.8155	0.9689	0.9878	0.9997	0.9999	0.9993	0.9995	1.0000
1970	0.0002	0.0001	0.0066	0.0205	0.0130	0.2394	0.7496	0.9608	0.9951	0.9977	1.0000	1.0000	0.9998	0.9999
1971	0.0007	0.0009	0.0012	0.0345	0.0898	0.1290	0.6837	0.9489	0.9927	0.9992	0.9996	1.0000	1.0000	1.0000
1972	0.0015	0.0030	0.0049	0.0099	0.1619	0.3171	0.6246	0.9369	0.9915	0.9987	0.9999	0.9999	1.0000	1.0000
1973	0.0006	0.0054	0.0137	0.0257	0.0785	0.5110	0.6861	0.9492	0.9903	0.9986	0.9998	1.0000	1.0000	1.0000
1974	0.0004	0.0023	0.0197	0.0600	0.1243	0.4199	0.8497	0.9114	0.9953	0.9986	0.9998	1.0000	1.0000	1.0000
1975	0.0000	0.0016	0.0093	0.0696	0.2269	0.4332	0.8602	0.9683	0.9798	0.9996	0.9998	1.0000	1.0000	1.0000
1976	0.0001	0.0001	0.0067	0.0370	0.2174	0.5744	0.8044	0.9812	0.9940	0.9956	1.0000	1.0000	1.0000	1.0000
1977	0.0007	0.0005	0.0008	0.0280	0.1361	0.5077	0.8613	0.9568	0.9978	0.9989	0.9991	1.0000	1.0000	1.0000
1978	0.0000	0.0028	0.0030	0.0058	0.1096	0.3927	0.7930	0.9662	0.9917	0.9997	0.9998	0.9998	1.0000	1.0000
1979	0.0001	0.0000	0.0106	0.0176	0.0417	0.3446	0.7263	0.9343	0.9924	0.9984	1.0000	1.0000	1.0000	1.0000
1980	0.0044	0.0008	0.0004	0.0400	0.0963	0.2442	0.6919	0.9159	0.9814	0.9983	0.9997	1.0000	1.0000	1.0000
1981	0.0003	0.0123	0.0047	0.0048	0.1390	0.3884	0.7056	0.9056	0.9781	0.9949	0.9996	0.9999	1.0000	1.0000
1982	0.0000	0.0014	0.0336	0.0275	0.0558	0.3849	0.7910	0.9467	0.9762	0.9946	0.9986	0.9999	1.0000	1.0000
1983	0.0000	0.0002	0.0059	0.0888	0.1453	0.4202	0.7081	0.9575	0.9925	0.9943	0.9987	0.9996	1.0000	1.0000
1984	0.0000	0.0001	0.0012	0.0240	0.2145	0.5050	0.8989	0.9039	0.9926	0.9990	0.9987	0.9997	0.9999	1.0000
1985	0.0000	0.0003	0.0007	0.0066	0.0930	0.4334	0.8596	0.9909	0.9733	0.9988	0.9999	0.9997	0.9999	1.0000
1986	0.0000	0.0001	0.0020	0.0051	0.0365	0.2992	0.6818	0.9735	0.9993	0.9930	0.9998	1.0000	0.9999	1.0000
1987	0.0000	0.0000	0.0012	0.0132	0.0369	0.1781	0.6401	0.8572	0.9955	0.9999	0.9982	1.0000	1.0000	1.0000
1988	0.0001	0.0001	0.0004	0.0111	0.0817	0.2224	0.5533	0.8811	0.9439	0.9992	1.0000	0.9995	1.0000	1.0000
1989	0.0000	0.0006	0.0018	0.0053	0.0947	0.3715	0.6807	0.8762	0.9686	0.9792	0.9999	1.0000	0.9999	1.0000
1990	0.0004	0.0002	0.0057	0.0233	0.0732	0.4938	0.7971	0.9408	0.9759	0.9923	0.9925	1.0000	1.0000	1.0000
1991	0.0006	0.0024	0.0033	0.0516	0.2401	0.5399	0.9009	0.9631	0.9916	0.9957	0.9981	0.9973	1.0000	1.0000
1992	0.0000	0.0036	0.0158	0.0507	0.3412	0.8071	0.9458	0.9883	0.9943	0.9989	0.9992	0.9996	0.9990	1.0000
1993	0.0001	0.0000	0.0210	0.0956	0.4611	0.8313	0.9823	0.9962	0.9987	0.9991	0.9998	0.9999	0.9999	0.9997
1994	0.0004	0.0007	0.0005	0.1136	0.4102	0.9319	0.9791	0.9986	0.9997	0.9999	0.9999	1.0000	1.0000	1.0000
1995	0.0021	0.0027	0.0076	0.0155	0.4336	0.8207	0.9955	0.9978	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
1996	0.0008	0.0091	0.0163	0.0728	0.3530	0.8205	0.9679	0.9997	0.9998	1.0000	1.0000	1.0000	1.0000	1.0000
1997	0.0004	0.0038	0.0383	0.0925	0.4474	0.9499	0.9647	0.9950	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1998	0.0000	0.0022	0.0177	0.1478	0.3853	0.8930	0.9985	0.9939	0.9992	1.0000	1.0000	1.0000	1.0000	1.0000
1999	0.0002	0.0004	0.0129	0.0773	0.4300	0.7941	0.9885	1.0000	0.9990	0.9999	1.0000	1.0000	1.0000	1.0000
2000	0.0023	0.0023	0.0065	0.0706	0.2811	0.7664	0.9596	0.9989	1.0000	0.9998	1.0000	1.0000	1.0000	1.0000
2001	0.0002	0.0104	0.0214	0.0961	0.3066	0.6459	0.9345	0.9932	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000
2002	**0.0009**	0.0016	0.0464	0.1722	0.6330	0.7201	0.8948	0.9841	0.9989	1.0000	1.0000	1.0000	1.0000	1.0000
2003	**0.0009**	**0.0048**	0.0102	0.1839	0.6644	0.9655	0.9374	0.9754	0.9963	0.9998	1.0000	1.0000	1.0000	1.0000
2004	**0.0009**	**0.0048**	**0.0260**	0.0629	0.5107	0.9496	0.9978	0.9886	0.9946	0.9991	1.0000	1.0000	1.0000	1.0000
2005	**0.0009**	**0.0048**	**0.0260**	**0.1397**	0.3039	0.8286	0.9945	0.9999	0.9980	0.9988	0.9998	1.0000	1.0000	1.0000
2006	**0.0009**	**0.0048**	**0.0260**	**0.1397**	**0.4930**	0.7394	0.9573	0.9994	1.0000	0.9997	0.9998	1.0000	1.0000	1.0000
2007	**0.0009**	**0.0048**	**0.0260**	**0.1397**	**0.4930**	**0.8392**	0.9486	0.9905	0.9999	1.0000	0.9999	0.9999	1.0000	1.0000
2008	**0.0009**	**0.0048**	**0.0260**	**0.1397**	**0.4930**	**0.8392**	**0.9668**	0.9917	0.9979	1.0000	1.0000	1.0000	1.0000	1.0000
2009	**0.0009**	**0.0048**	**0.0260**	**0.1397**	**0.4930**	**0.8392**	**0.9668**	**0.9939**	0.9987	0.9996	1.0000	1.0000	1.0000	1.0000

Table 18. Mean numbers per tow at age for the fall industry (GEAC) trawl survey of the offshore portion of NAFO Subdiv. 3Ps. The 1997 and 1998 cohorts are highlighted (shaded cells).

Age/Year	1997	1998	1999	2000	2001	2002	2003	2004
1	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.00
2	0.29	0.06	0.34	1.64	0.21	0.00	0.22	0.08
3	3.28	0.40	1.14	7.24	12.47	1.26	0.41	0.68
4	9.42	1.76	1.71	2.86	26.74	16.88	2.46	0.80
5	13.62	2.32	2.83	3.35	3.75	18.47	8.34	1.07
6	3.02	1.81	3.58	5.18	2.14	2.90	9.28	2.98
7	10.03	0.35	3.27	5.89	1.62	1.39	1.32	1.18
8	11.97	1.64	0.51	3.99	1.34	1.18	0.73	0.15
9	1.34	3.40	1.43	1.14	0.96	0.91	1.32	0.12
10	0.54	0.40	1.36	5.83	0.10	0.46	0.48	0.18
11	0.24	0.04	0.17	7.14	0.44	0.09	0.24	0.13
12	0.04	0.13	0.10	0.79	0.58	0.27	0.00	0.05
13	0.00	0.22	0.02	0.11	0.08	0.30	0.16	0.00
14	0.00	0.00	0.00	0.17	0.05	0.00	0.15	0.13
15	0.00	0.04	0.00	0.00	0.03	0.00	0.03	0.06
Totals	53.79	12.58	16.46	45.33	50.54	44.11	25.14	7.61

Table 18. Mean numbers per tow at age for the fall industry (GEAC) trawl survey of the offshore portion of NAFO Subdiv. 3Ps. The 1997 and 1998 cohorts are highlighted (shaded cells).

Age/Year	1997	1998	1999	2000	2001	2002	2003	2004
1	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.00
2	0.29	0.06	0.34	1.64	0.21	0.00	0.22	0.08
3	3.28	0.40	1.14	7.24	12.47	1.26	0.41	0.68
4	9.42	1.76	1.71	2.86	26.74	16.88	2.46	0.80
5	13.62	2.32	2.83	3.35	3.75	18.47	8.34	1.07
6	3.02	1.81	3.58	5.18	2.14	2.90	9.28	2.98
7	10.03	0.35	3.27	5.89	1.62	1.39	1.32	1.18
8	11.97	1.64	0.51	3.99	1.34	1.18	0.73	0.15
9	1.34	3.40	1.43	1.14	0.96	0.91	1.32	0.12
10	0.54	0.40	1.36	5.83	0.10	0.46	0.48	0.18
11	0.24	0.04	0.17	7.14	0.44	0.09	0.24	0.13
12	0.04	0.13	0.10	0.79	0.58	0.27	0.00	0.05
13	0.00	0.22	0.02	0.11	0.08	0.30	0.16	0.00
14	0.00	0.00	0.00	0.17	0.05	0.00	0.15	0.13
15	0.00	0.04	0.00	0.00	0.03	0.00	0.03	0.06
Totals	53.79	12.58	16.46	45.33	50.54	44.11	25.14	7.61

Table 19. Inputs for the four sequential population analysis runs conducted during the October 2005 assessment of NAFO Subdiv. 3Ps cod. The rate of natural mortality (*m*) was assumed to be 0.2 per year for all ages. See text for details of indices.

Inputs	**QLSPA-2005** **Run B**	**XSA-2005** **Run C**	**ADAPT-2005** **Run D**	**ADAPT-2005** **Run E**
Catch-at-age	1977-2004; ages 2-14	1977-2004; ages 2-14	1977-2004; ages 2-14	1977-2004; ages 2-14
Cameron index	1977-1982; ages 2-14	1977-1982; ages 2-14	1977-1982; ages 2-14	1977-1982; ages 2-14
DFO RV index (not split)	1983-2005; ages 2-14	1983-2005; ages 2-14	1983-2005; ages 2-12	1983-2005; ages 2-12
GEAC index	1998-2004; ages 2-14	1998-2004; ages 2-14	1998-2004; ages 2-12[1]	1998-2004; ages 2-12[1]
Sentinel linetrawl index[2]	1995-2004; ages 3-10	1995-2004; ages 3-10	1995-2004; ages 3-10	1995-2004; ages 3-10

[1] Only ages 2-12 were used in the ADAPT formulation to minimize the influence of large numbers of zeros among the oldest ages.

[2] The sentinel gillnet index was not used in any of the SPA analyses conducted at the 2005 assessment.

Table 20. Inputs and structure for the projection of 3Ps cod spawner biomass from 1 April 2005 to 1 April 2008 based on ADAPT SPA runs D and E from the October 2005 assessment.

Proportion of TAC or F

Year	Period From	To	Prop
2005	1-Apr	31-Dec	0.83
2006	1-Jan	31-Mar	0.17
2006	1-Apr	31-Dec	0.83
2007	1-Jan	31-Mar	0.17
2007	1-Apr	31-Dec	0.83
2008	1-Jan	31-Mar	0.17

Partial Recruitment

To be computed from the average of the PR for the period 2002-2004 from the relevant SPA

Method is to calculated the PR in each year, take the average, and then rescale the vector to have a maximum of 1

Run/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
Run D	0.00	0.02	0.07	0.19	0.47	0.84	1.00	0.72	0.71	0.59	0.40	0.18	0.10
Run E	0.00	0.01	0.04	0.13	0.34	0.68	1.00	0.92	1.00	0.96	0.84	0.63	0.81

Recruitment at age 3

Geometric mean of numbers at age 3 in 2003-2005 from the relevant SPA

Run D	11,714
Run E	9,479

Natural mortality

M = 0.2

Population weight at age (Jan 1)

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
2005	0.000	0.522	0.797	1.223	1.770	2.199	2.607	3.315	4.133	4.388	5.006	7.184	8.518
2006	0.000	0.522	0.797	1.223	1.770	2.199	2.607	3.315	4.133	4.388	5.006	7.184	8.518
2007	0.000	0.522	0.797	1.223	1.770	2.199	2.607	3.315	4.133	4.388	5.006	7.184	8.518
2008	0.000	0.522	0.797	1.223	1.770	2.199	2.607	3.315	4.133	4.388	5.006	7.184	8.518

Catch weights at age (mid-year)

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
2005	0.000	0.6118	0.9842	1.4925	2.0619	2.3858	2.818	3.6264	4.5293	4.8153	5.53	7.9145	8.9707
2006	0.000	0.6118	0.9842	1.4925	2.0619	2.3858	2.818	3.6264	4.5293	4.8153	5.53	7.9145	8.9707
2007	0.000	0.6118	0.9842	1.4925	2.0619	2.3858	2.818	3.6264	4.5293	4.8153	5.53	7.9145	8.9707
2008	0.000	0.6118	0.9842	1.4925	2.0619	2.3858	2.818	3.6264	4.5293	4.8153	5.53	7.9145	8.9707

Maturity at age

Year/Age	2	3	4	5	6	7	8	9	10	11	12	13	14
2005	0.005	0.026	0.140	0.304	0.829	0.994	1.000	0.998	0.999	1.000	1.000	1.000	1.000
2006	0.005	0.026	0.140	0.493	0.739	0.957	0.999	1.000	1.000	1.000	1.000	1.000	1.000
2007	0.005	0.026	0.140	0.493	0.839	0.949	0.990	1.000	1.000	1.000	1.000	1.000	1.000
2008	0.005	0.026	0.140	0.493	0.839	0.967	0.992	0.998	1.000	1.000	1.000	1.000	1.000

Table 21. Comparison of results from 3-year deterministic projections from 1 April 2006 to 1 April 2008 at fixed annual catch options ranging from 5,000 t to 15,000 t for the NAFO Subdiv. 3Ps cod stock. Note that 1 April 2006 values are for the end of the current management year and assume that the 15,000 t TAC will be caught. Results are given in terms of percent change in spawning stock biomass (SSB) on 1 April 2006 and 1 April 2007 for two ADAPT SPA formulations. Negative values (shaded cells) indicate lower SSB at the end of the projection period.

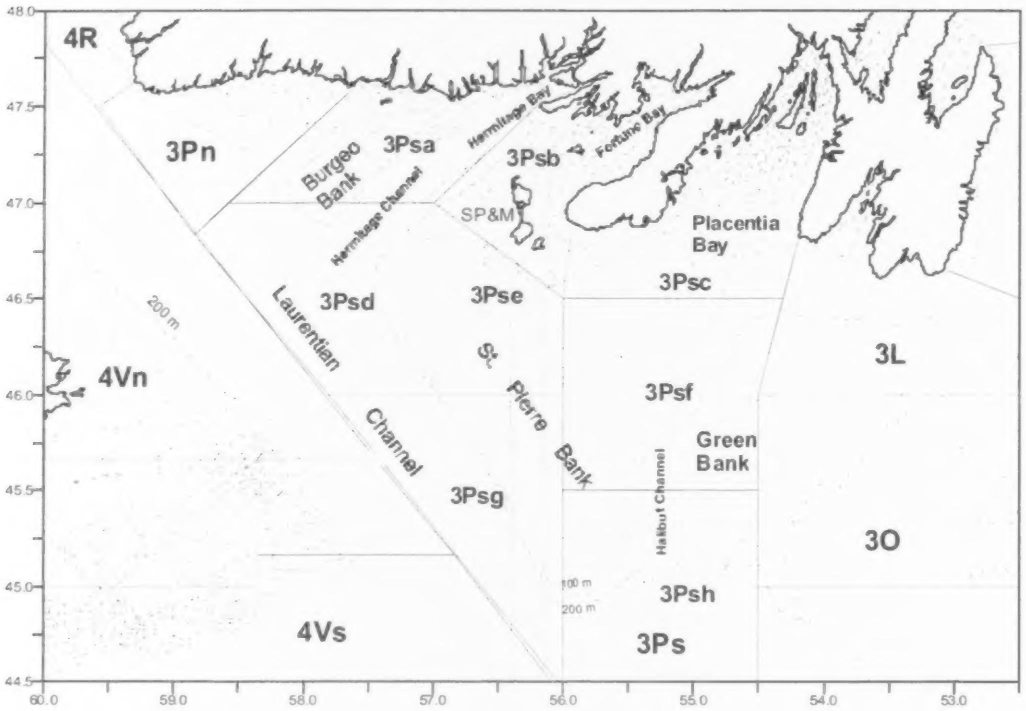
	Management	% change in SSB from 74,900t (Apr.1/2005)				
	year	5,000 t	7,500 t	10,000t	12,500 t	15,000 t
ADAPT	2005/06					-6
Run 1	2006/07	1%	-2%	-5%	-8%	-11%
(domed)	2007/08	5%	-1%	-7%	-13%	-20%

	Management	% change in SSB from 44,400 t (Apr.1/ 2005)				
	year	5,000 t	7,500 t	10,000t	12,500 t	15,000 t
ADAPT	2005/06					-13%
Run 2	2006/07	-1%	-6%	-12%	-17%	-22%
flat-topped	2007/08	8%	-3%	-13%	-24%	-34%

Table 21. Comparison of results from 3-year deterministic projections from 1 April 2006 to 1 April 2008 at fixed annual catch options ranging from 5,000 t to 15,000 t for the NAFO Subdiv. 3Ps cod stock. Note that 1 April 2006 values are for the end of the current management year and assume that the 15,000 t TAC will be caught. Results are given in terms of percent change in spawning stock biomass (SSB) on 1 April 2006 and 1 April 2007 for two ADAPT SPA formulations. Negative values (shaded cells) indicate lower SSB at the end of the projection period.

	Management year	% change in SSB from 74,900t (Apr.1/2005)				
		5,000 t	7,500 t	10,000t	12,500 t	15,000 t
ADAPT	2005/06					-6
Run 1	2006/07	1%	-2%	-5%	-8%	-11%
(domed)	2007/08	5%	-1%	-7%	-13%	-20%

	Management year	% change in SSB from 44,400 t (Apr.1/ 2005)				
		5,000 t	7,500 t	10,000t	12,500 t	15,000 t
ADAPT	2005/06					-13%
Run 2	2006/07	-1%	-6%	-12%	-17%	-22%
flat-topped	2007/08	8%	-3%	-13%	-24%	-34%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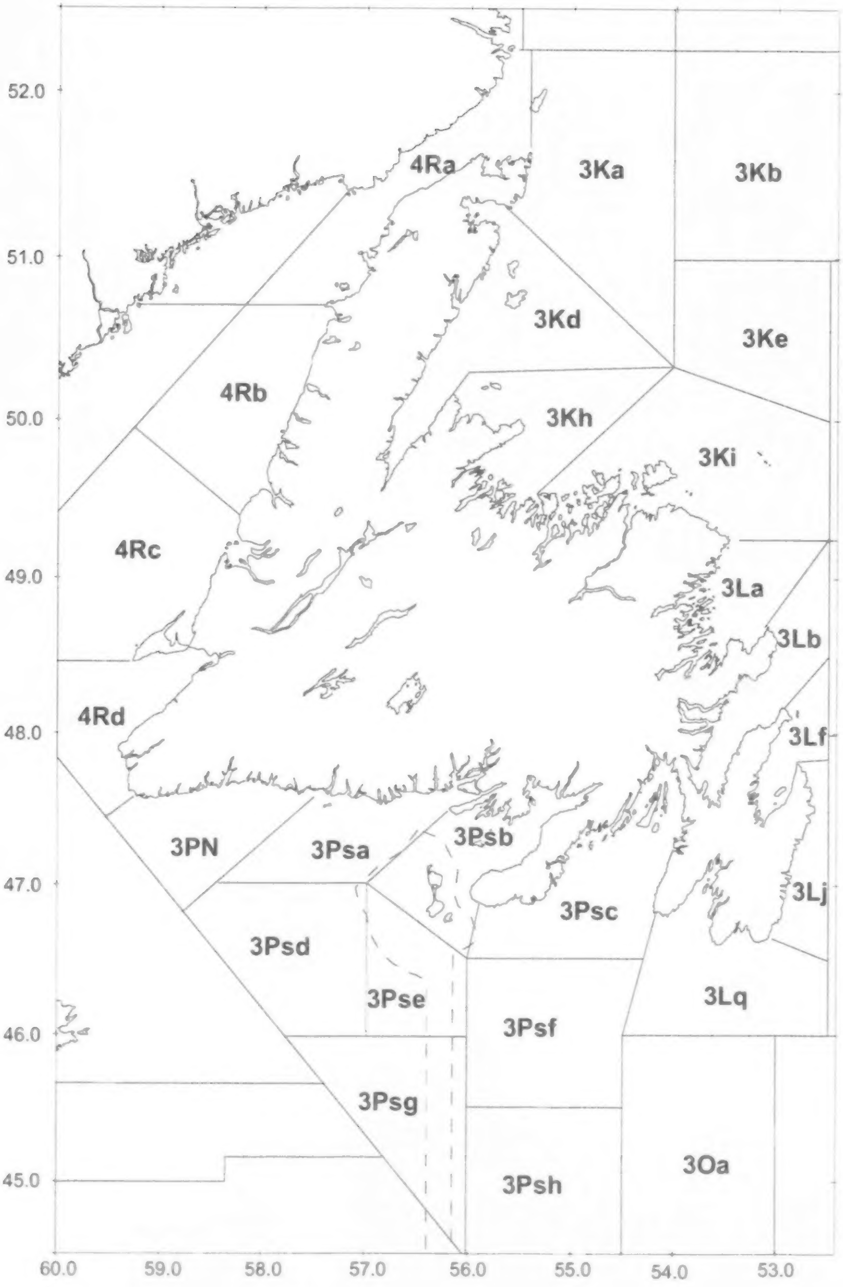
4R
3Pn
Burgeo Bank
3Psa
Hermitage Bay
3Psb
Fortune Bay
Hermitage Channel
SP&M
Placentia Bay
3Psc
3Psd
3Pse
200 m
Laurentian Channel
St. Pierre Bank
4Vn
3Psf
3L
Green Bank
Halibut Channel
3Psg
3O
100 m
200 m
3Psh
4Vs
3Ps

Fig. 1. NAFO Subdivision 3Ps management unit showing French economic zone (fine dashed line), boundaries of statistical unit areas, 100m and 200m depth contours, and main fishing areas.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3Ki
3La
3Lb
3Lf
3Lj
3Lq
3PN
3Psa
3Psb
3Psc
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3Psg
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3Oa

Fig. 2. Names and boundaries of NAFO statistical areas around insular Newfoundland. The dashed line indicates the boundary of the French economic zone.

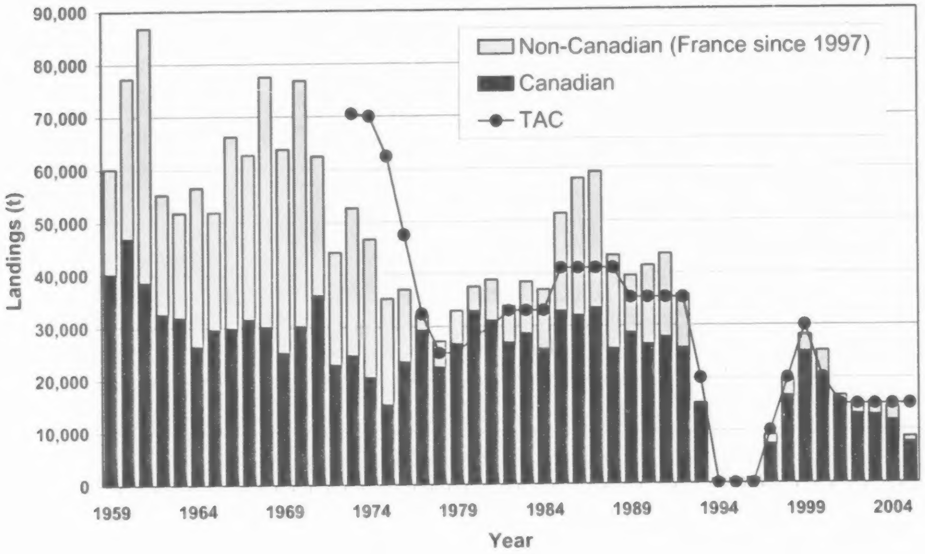


Fig. 3a. Reported landings of cod by Canadian and non-Canadian vessels in NAFO Subdiv. 3Ps during 1959 - 20 September 2005

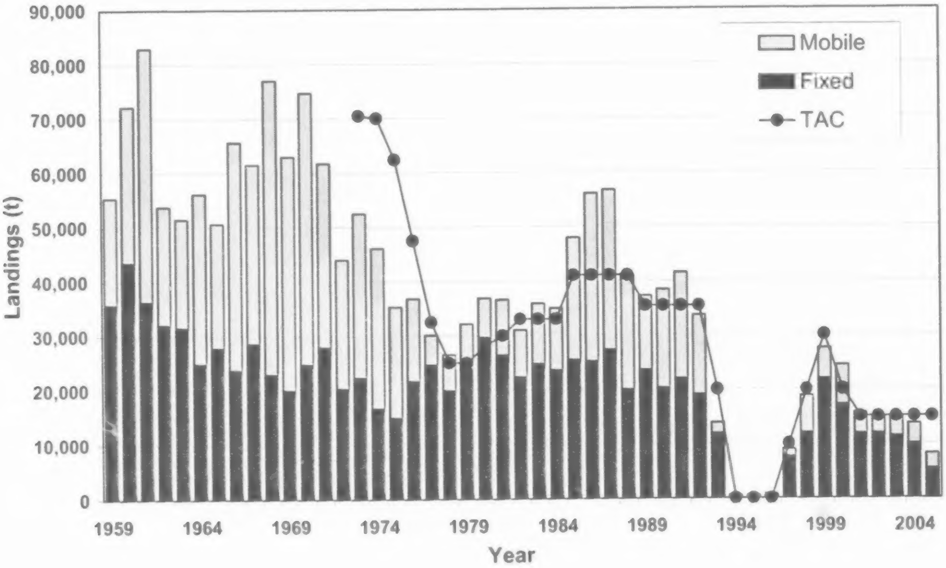


Fig. 3b. Reported landings of cod by fixed and mobile gear vessels in NAFO Subdiv. 3Ps from 1959 until 20 September 2005.

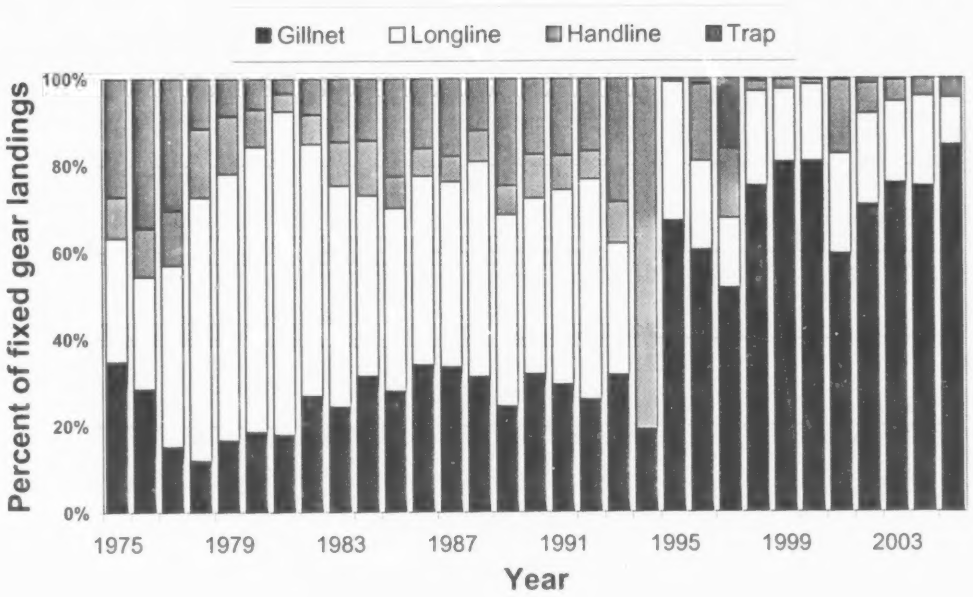


Fig. 4. Percent of fixed gear landings by the four main fixed gears used in the cod fishery in NAFO Subdiv. 3Ps during 1975 - 20 September 2005. The fishery was under a moratorium during 1994-1996 and values for those years are based on sentinel and by-catch landings of < 800 t. The values for 2005 are based on fixed gear landings to 20 September (about 5,800 t) as the fishery was still in progress.

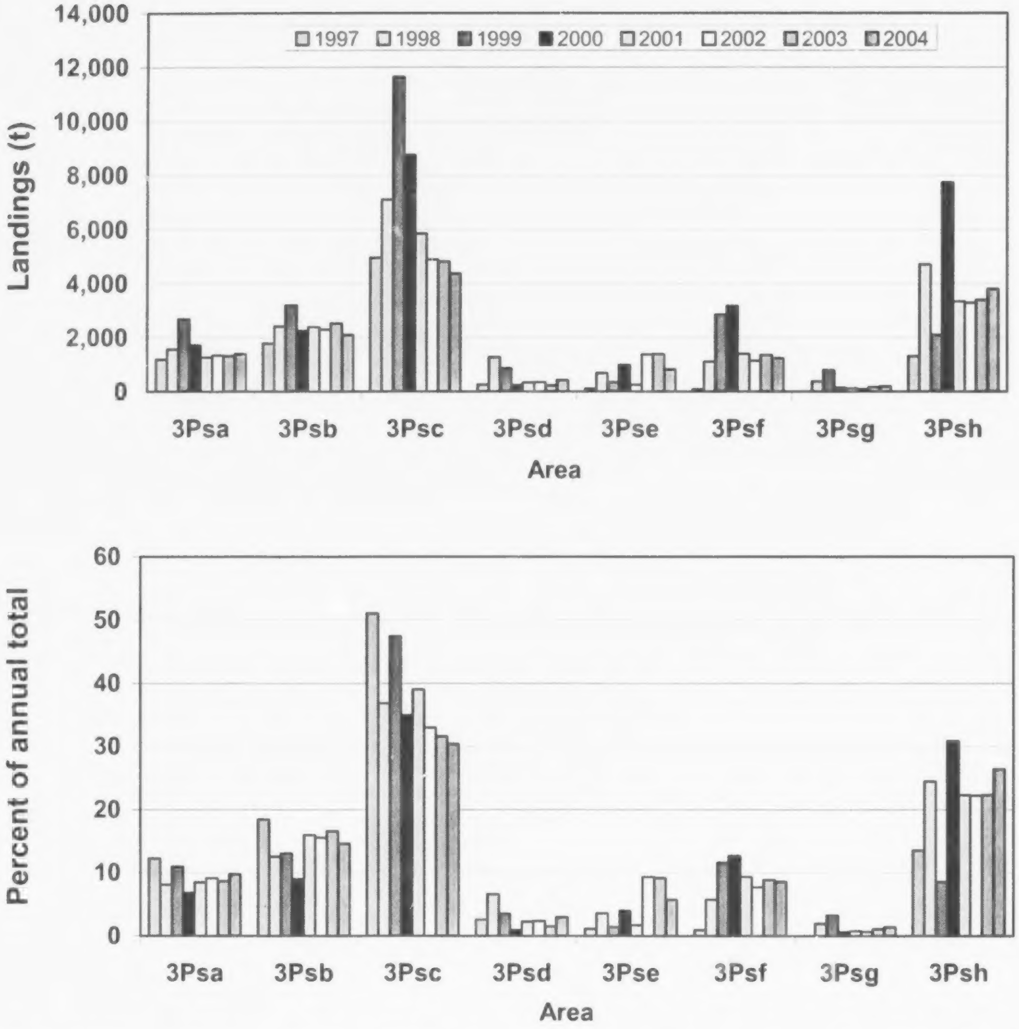


Fig. 5. Annual reported landings of cod by unit area from NAFO Subdiv. 3Ps during 1997-2004.

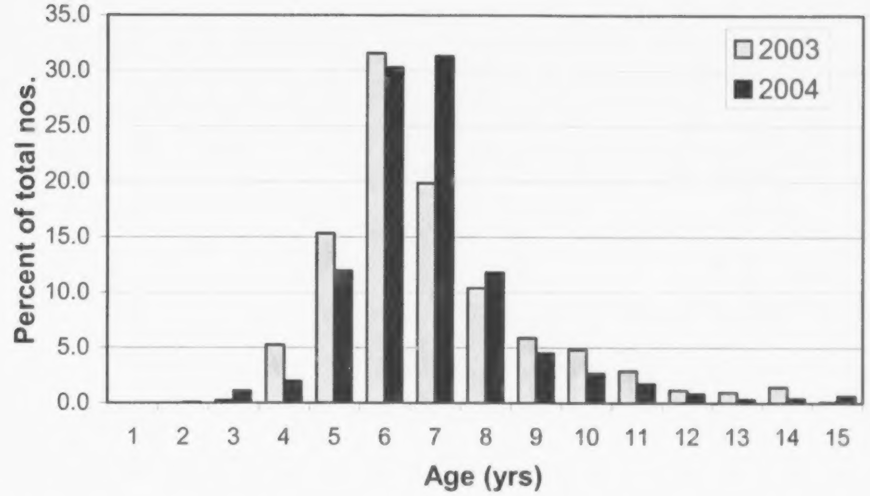


Fig. 6a. Catch-at-age (percents) for the commercial cod fishery in NAFO Subdiv. 3Ps. Comparison of 2003 with 2004.

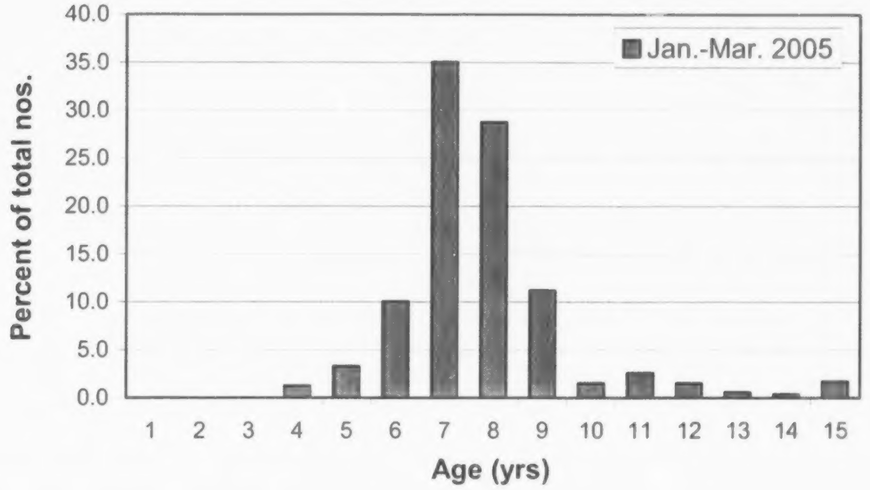
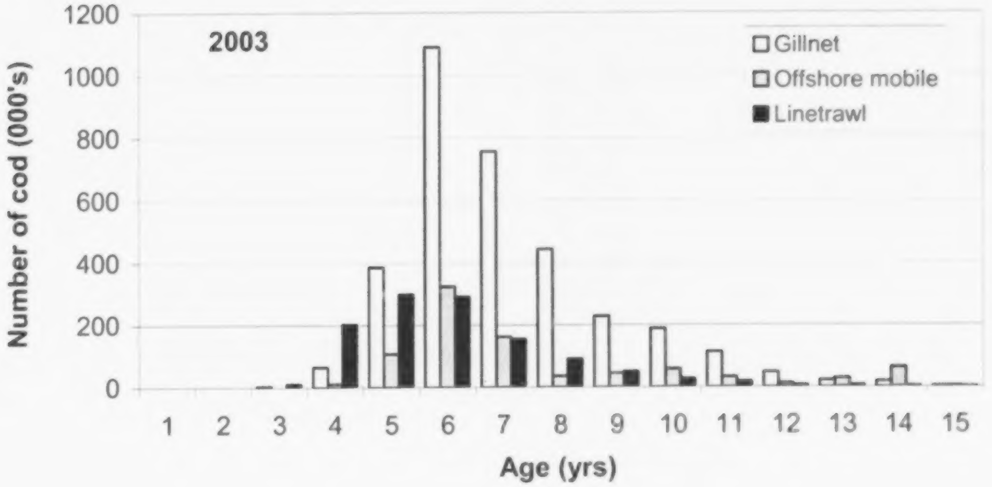


Fig. 6b. Catch-at-age (percents) for the commercial cod fishery in NAFO Subdiv. 3Ps during January-March 2005.



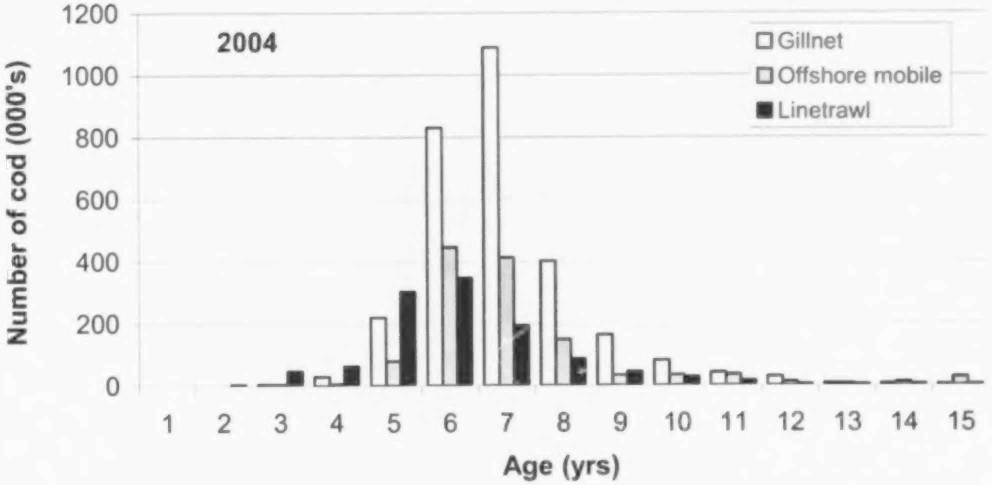


Fig. 7. Catch numbers-at-age for the main gear types used in the cod fishery in NAFO Subdiv. 3Ps during 2003 and 2004.

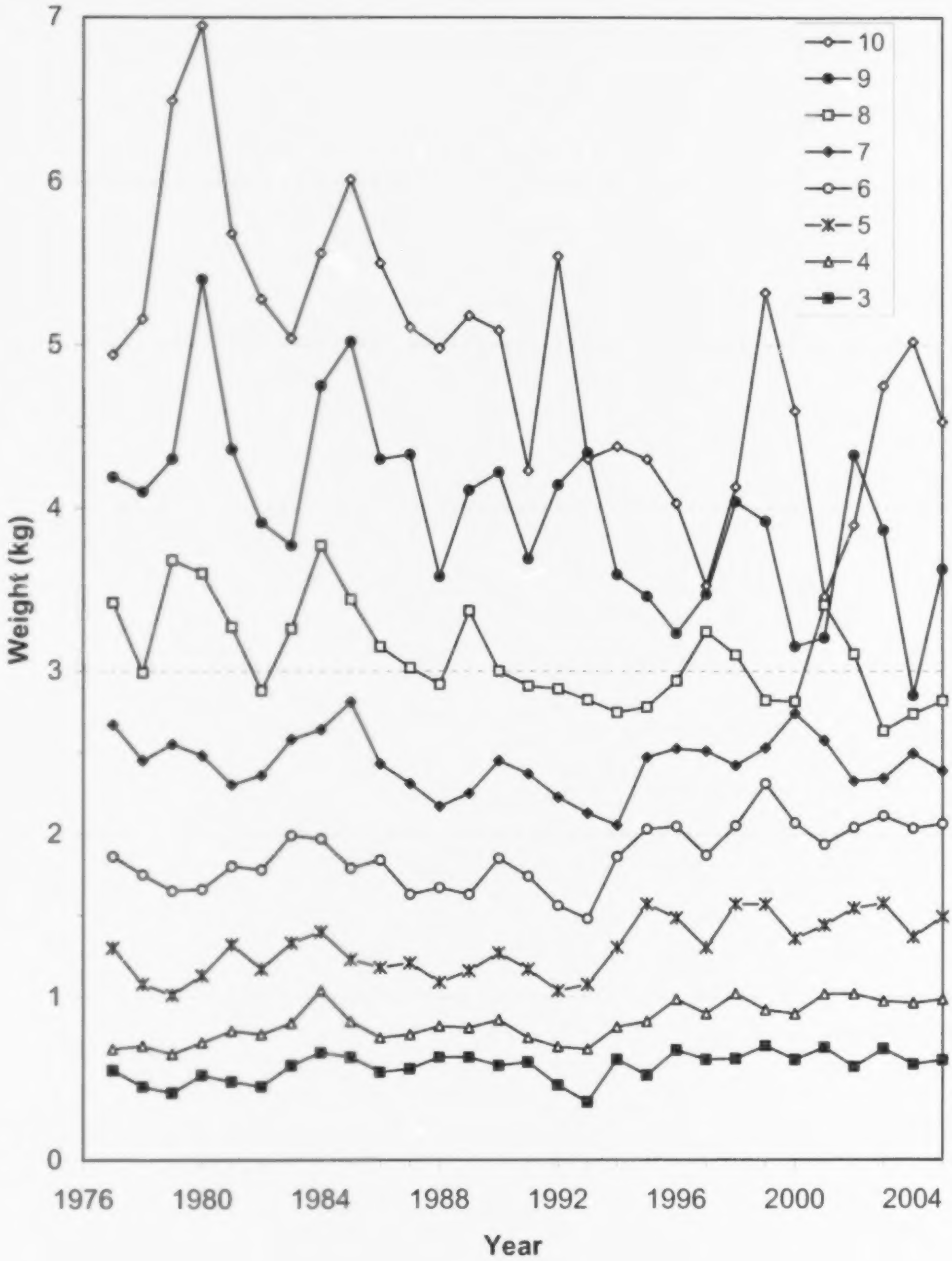


Fig. 8a. Mean weights-at-age calculated from mean lengths-at-age for the commercial catch of cod in NAFO Subdiv. 3Ps during 1977-2005.

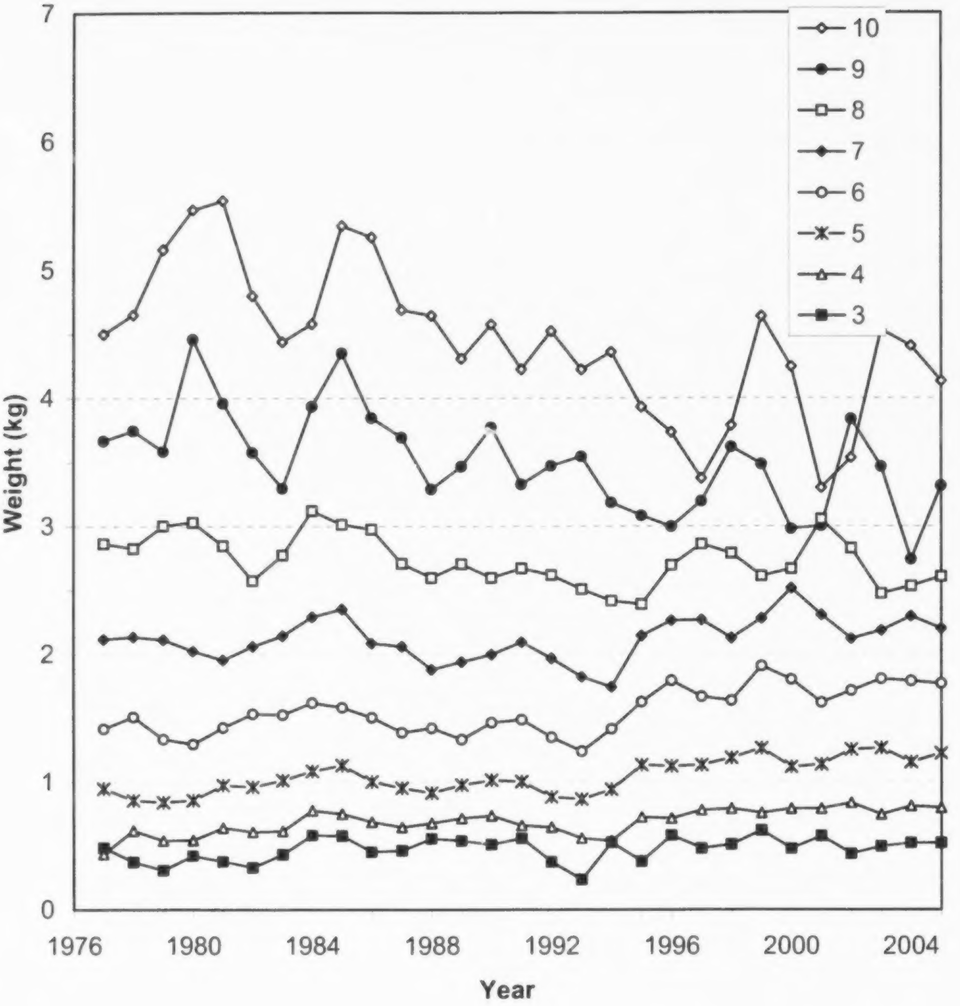


Fig. 8b. Beginning of year mean weights-at-age (3-10) from the commercial catch of cod in NAFO Subdiv. 3Ps during 1977-2005. The values for 2005 are computed using extrapolated values for mid-year weights for 2005, as described in the text.

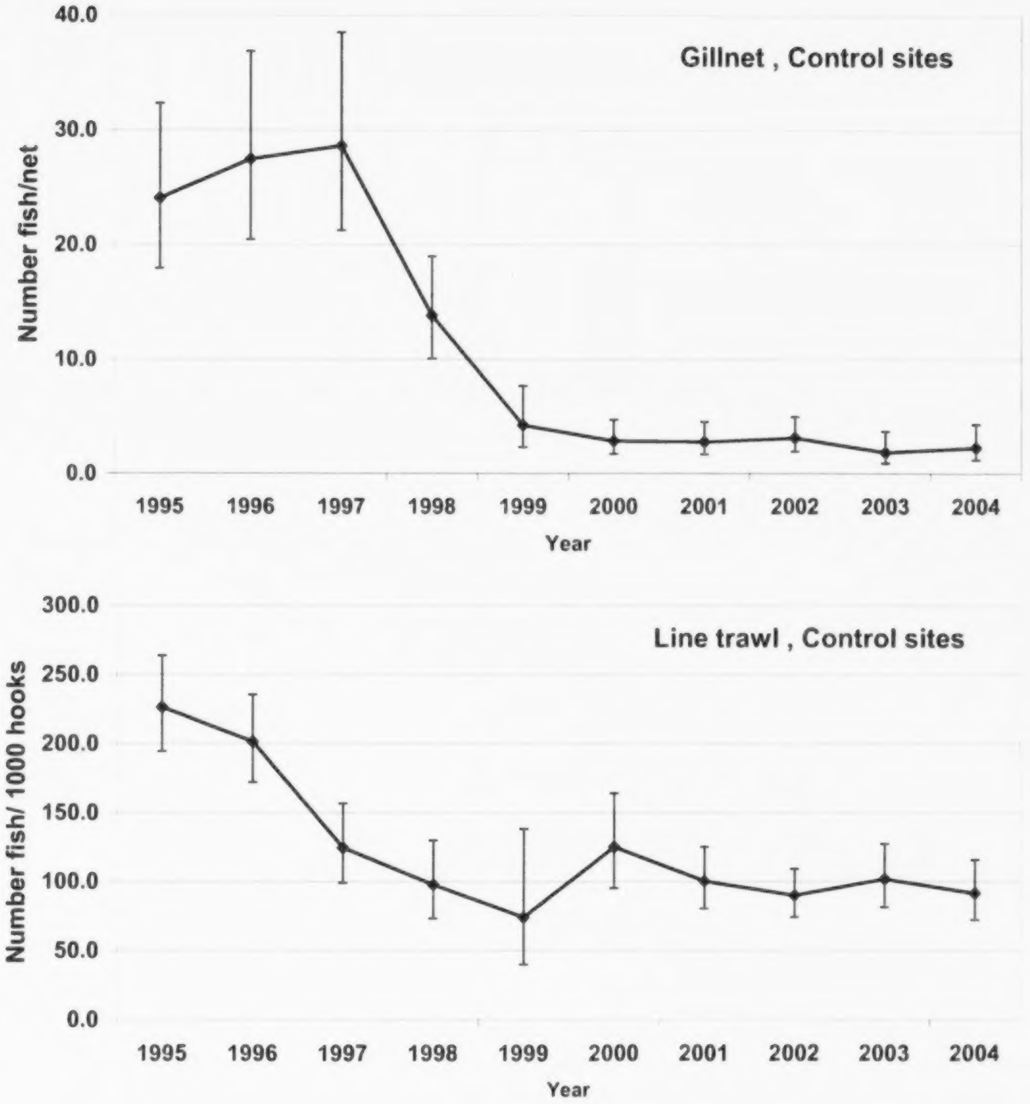
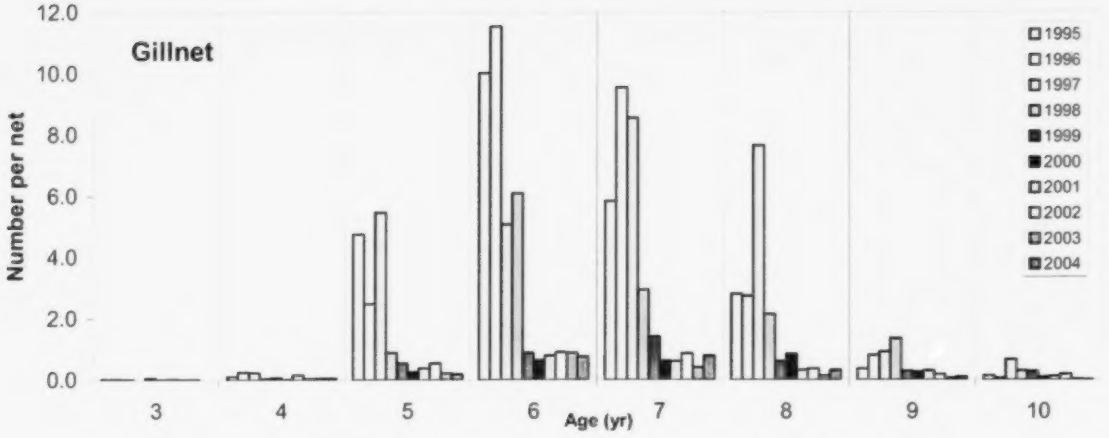


Fig. 9a. Standardized age-aggregated catch rate indices for gill nets (5.5" mesh) and line-trawls (with 95% CL's) estimated using data from sentinel fishery fixed sites. Catch rates are fish per 50 fathom net for gill nets and fish per 1,000 hooks for line trawl.



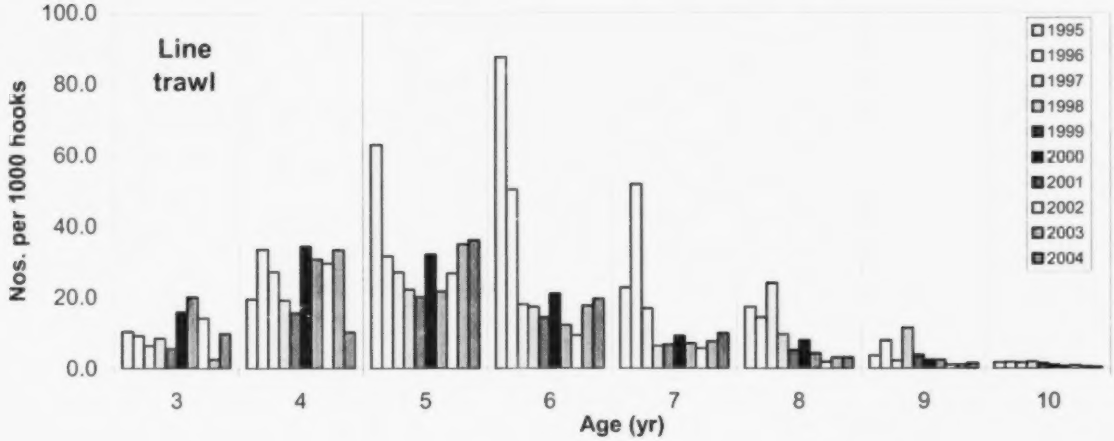


Fig. 9b. Standardized age-disaggregated catch rate indices for gill nets (5.5" mesh) and line-trawls estimated using data from sentinel fishery fixed sites. Catch rates are fish per 50 fathom net for gill nets and fish per 1,000 hooks for line trawl.

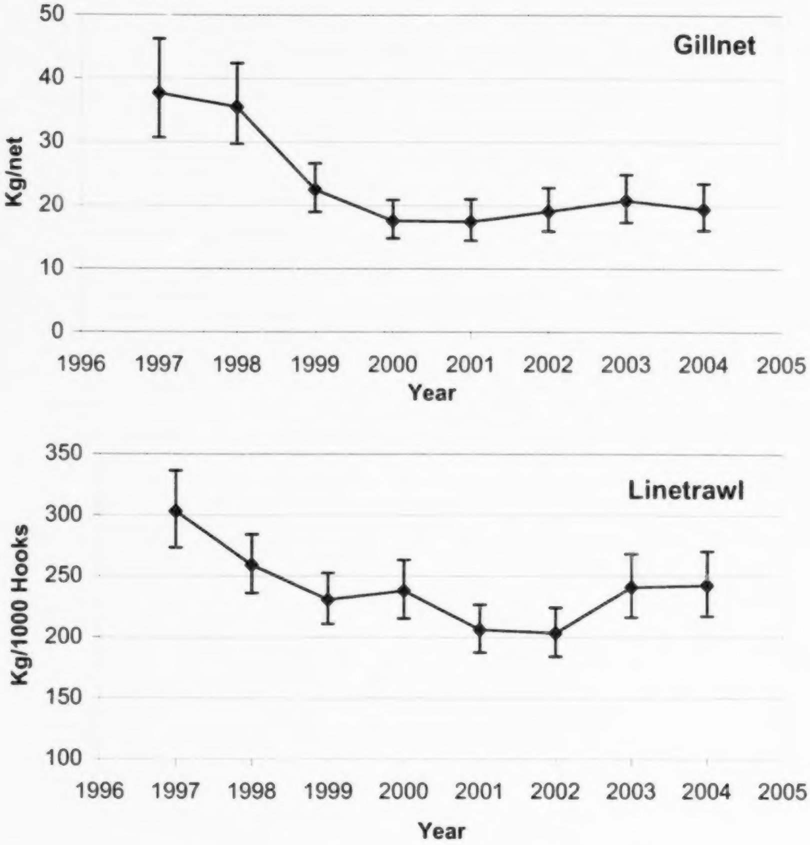


Fig. 10. Standardized annual catch rate indices (with 95% CL's) for gillnets and line-trawls using data from science logbooks for the <35 ft sector. Catch rate is live weight equivalence (kg).

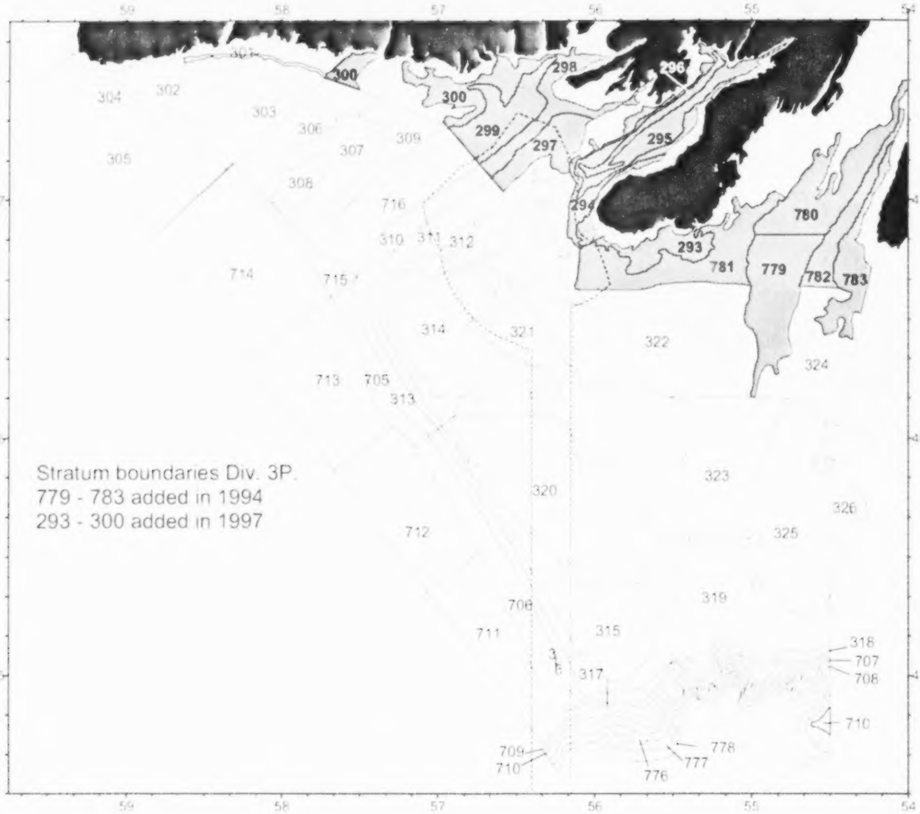

Stratum boundaries Div. 3P.
779 - 783 added in 1994
293 - 300 added in 1997
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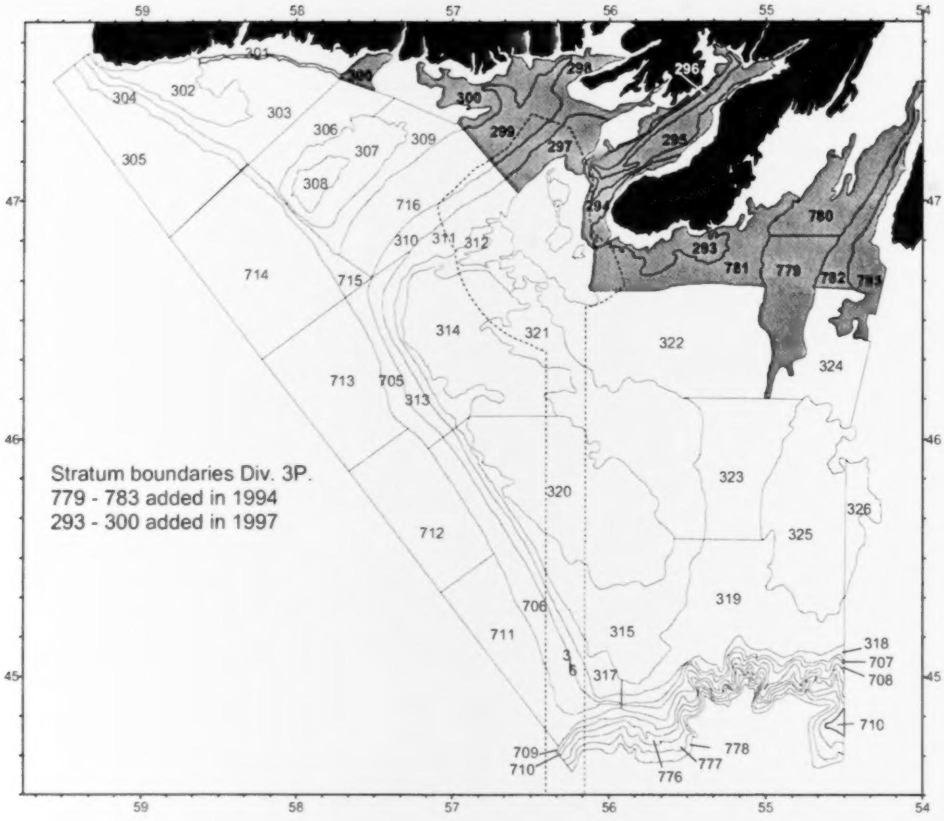
Fig. 11. Stratum area boundaries and area surveyed during the DFO research vessel bottom-trawl survey of NAFO Subdiv. 3Ps. Dashed line is the boundary of the French economic zone which is included in the surveyed area.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Stratum boundaries Div. 3P.
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Fig. 11. Stratum area boundaries and area surveyed during the DFO research vessel bottom-trawl survey of NAFO Subdiv. 3Ps. Dashed line is the boundary of the French economic zone which is included in the surveyed area.

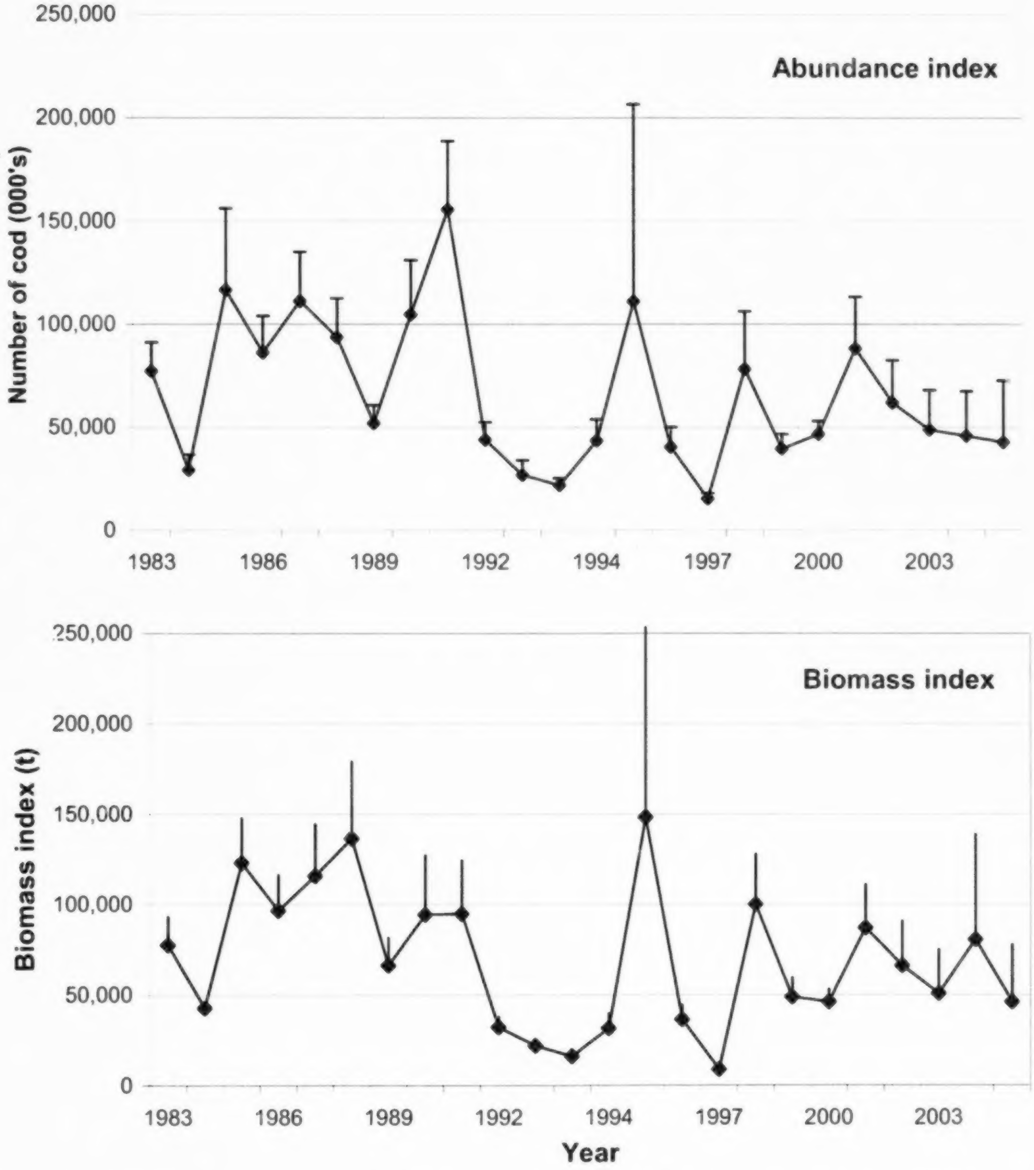


Fig. 12. Abundance and biomass indices for cod in NAFO Subdiv. 3Ps from DFO research vessel bottom trawl surveys during winter/spring from 1983-2005. There were two surveys in 1993. Error bars show plus one standard deviation.

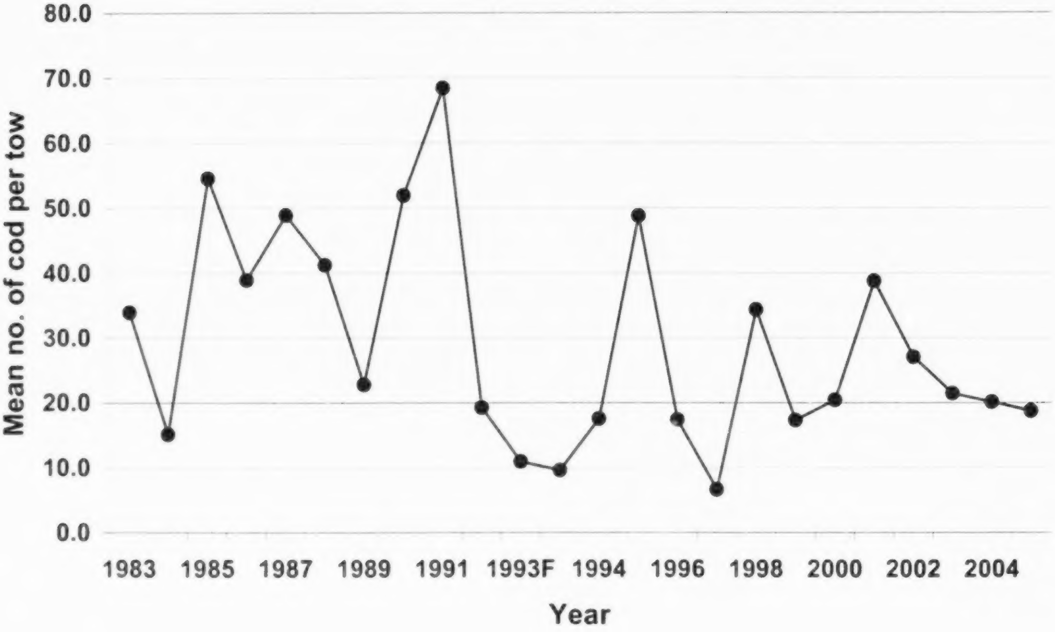


Fig. 13. Age-aggregated catch rate index (mean numbers per tow in Campelen units) from the DFO research vessel bottom trawl survey of NAFO Subdiv. 3Ps conducted during winter/spring (1983-2005). There were two surveys in 1993 (February and April).

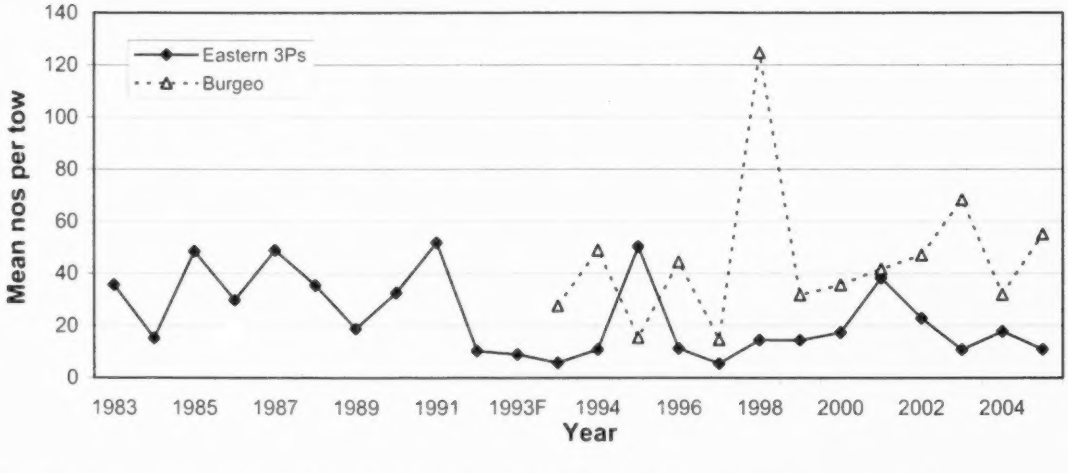


Fig. 14. Age-aggregated catch rate index for the eastern and western (Burgeo area) portions of 3Ps from the DFO research vessel bottom trawl surveys. There were two surveys in 1993.

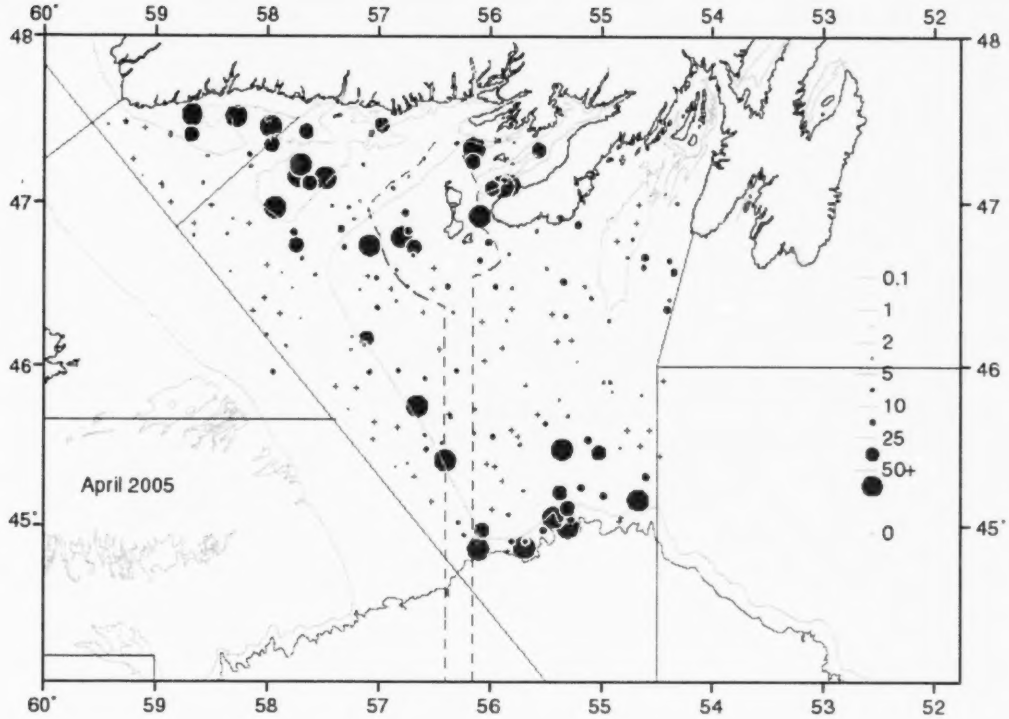

60°
59
58
57
56
55
54
53
52
48
47
46
45°
April 2005
0.1
1
2
5
10
25
50+
0

Fig. 15. Age-aggregated distribution of cod catches (nos per tow) from the DFO RV survey of NAFO Div. 3P during April 2005.

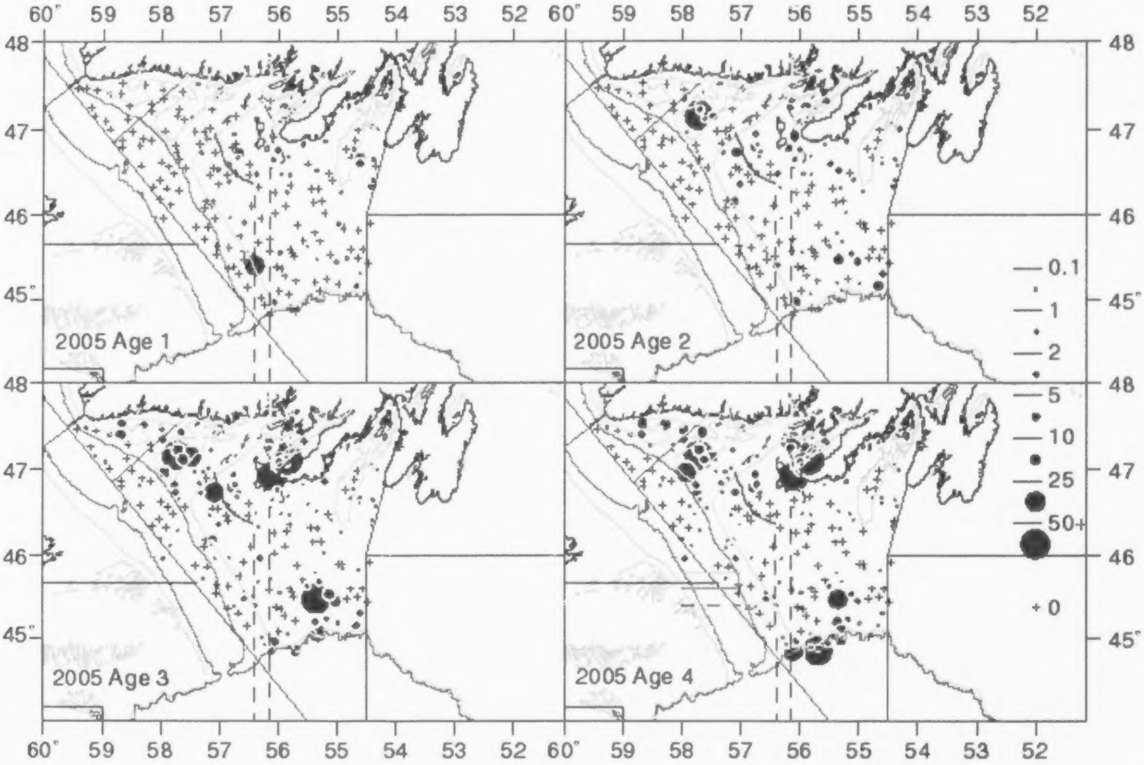

2005 Age 1
2005 Age 2
2005 Age 3
2005 Age 4
60°
59
58
57
56
55
54
53
52
48
47
46
45°
0.1
1
2
5
10
25
50+
+ 0

Fig. 16. Age dis-aggregated distribution of of cod (ages 1-4) catches for the DFO RV bottom trawl survey of NAFO Div. 3P. during April 2005.

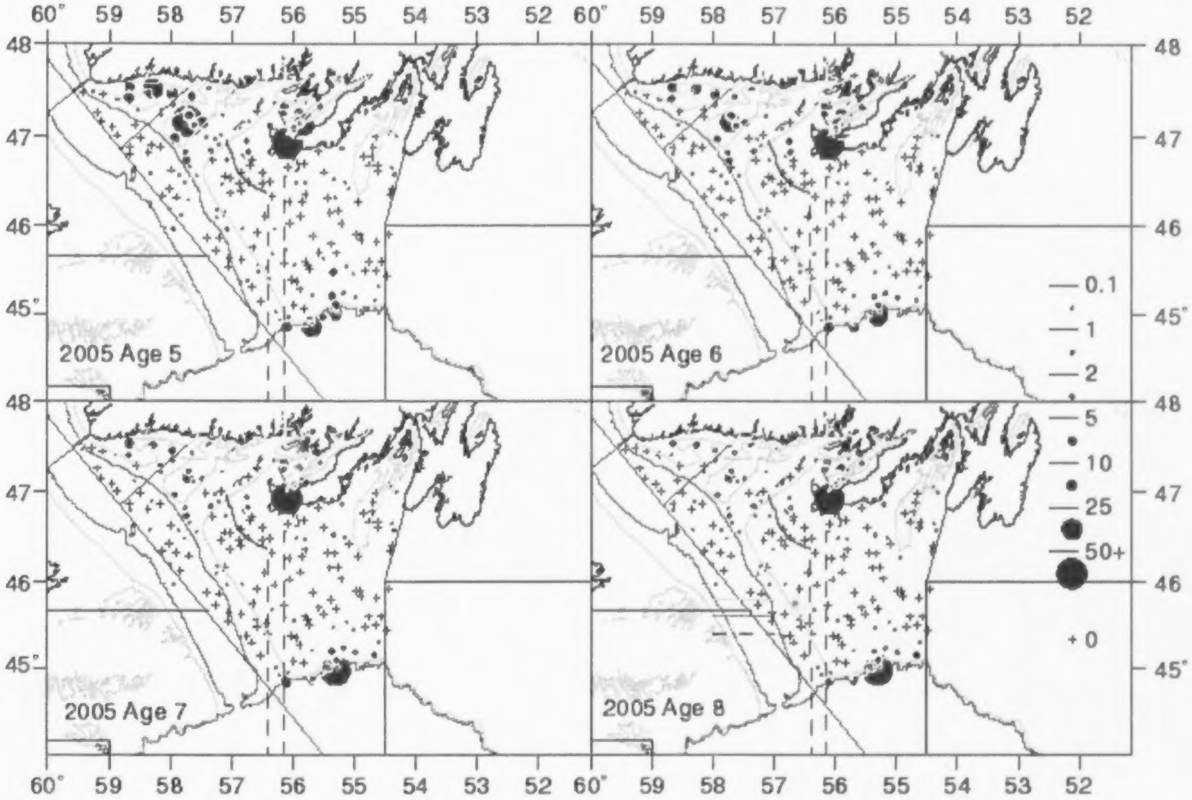

60°
59
58
57
56
55
54
53
52
48
47
46
45°
2005 Age 5
2005 Age 6
2005 Age 7
2005 Age 8
0.1
1
2
5
10
25
50+
+ 0

Fig. 17. Age dis-aggregated distribution of of cod (ages 5-8) catches for the DFO RV bottom trawl survey of NAFO Div. 3P. during April 2005.

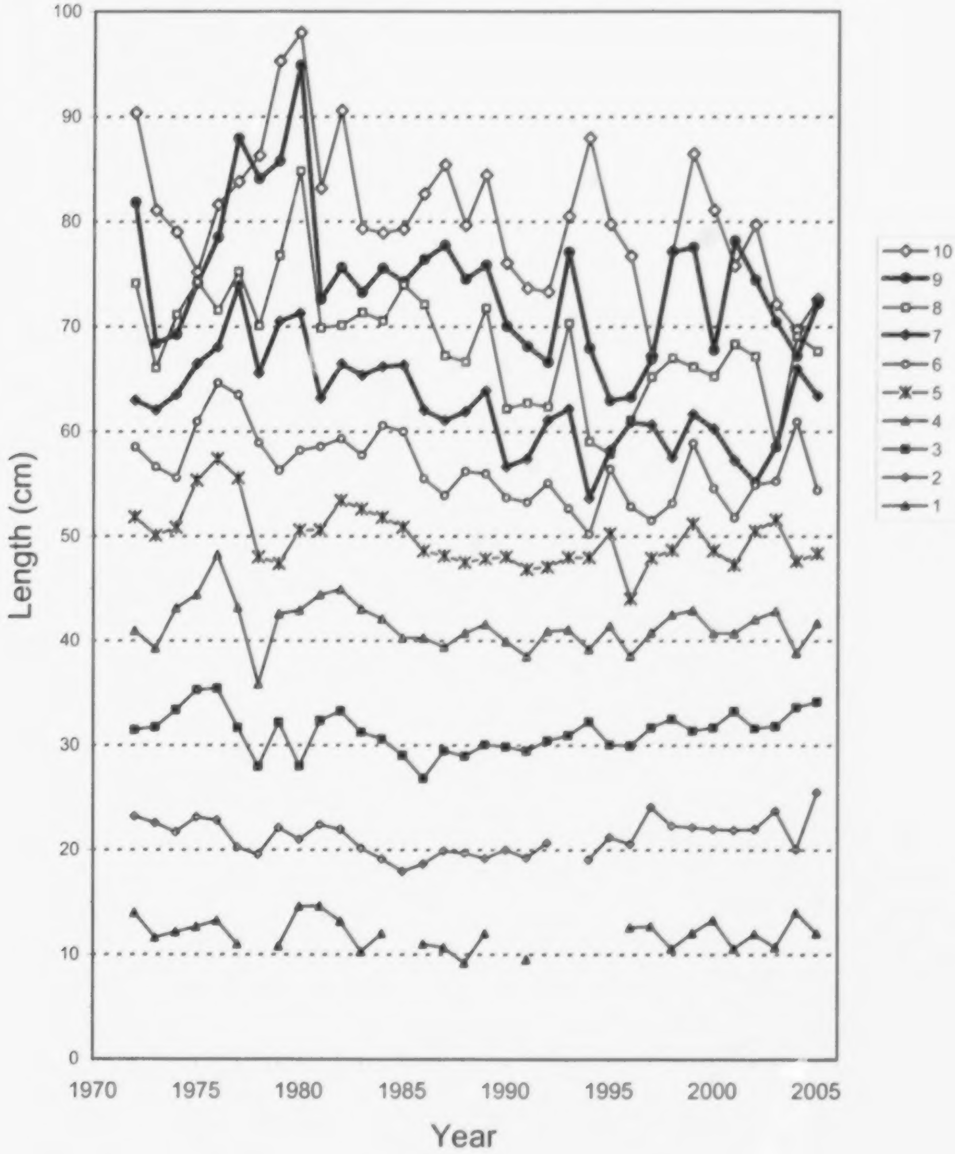


Fig. 18a. Mean length at ages 1-10 of cod in Subdivision 3Ps during 1974-2005, as determined from sampling during DFO bottom-trawl surveys in winter-spring.

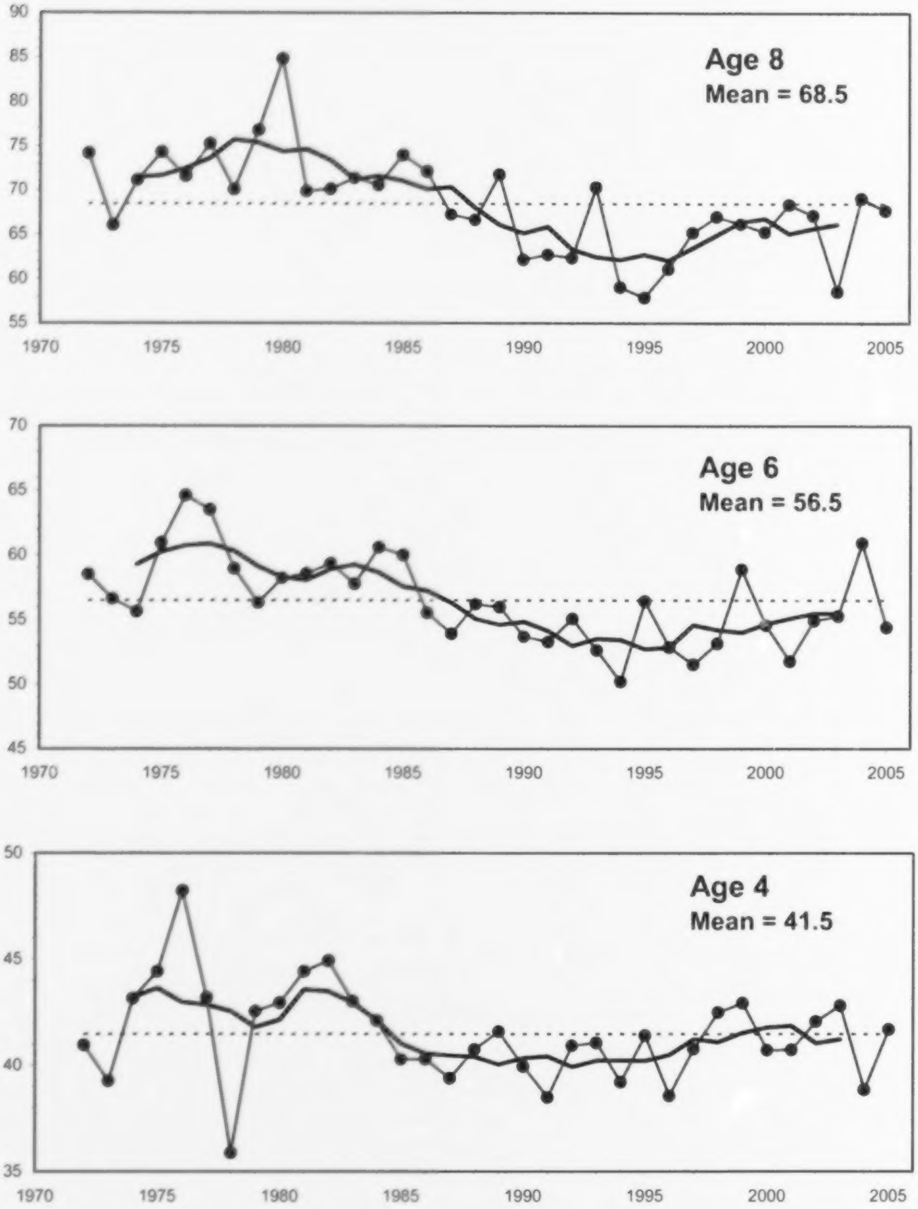


Fig. 18b. Mean lengths (cm) at ages 4, 6 and 8 of cod in Subdivision 3Ps during 1972 2005, as determined from sampling during DFO bottom-trawl surveys in winter-spring The lines in each panel indicate the annual means (solid line with symbols), a 5-year running mean (heavy solid line) and the mean for the period 1972-2005 (dashed line)

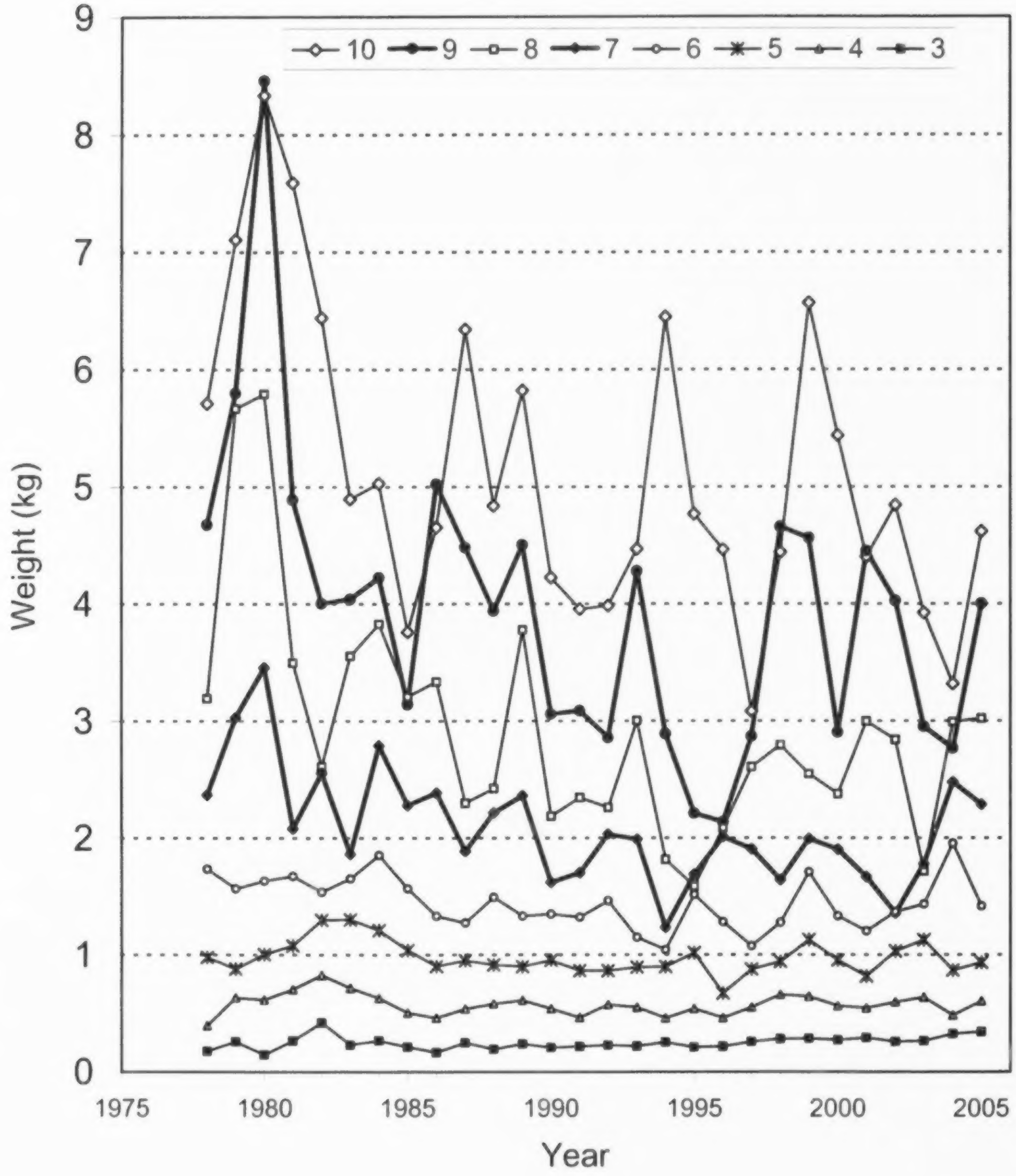


Fig. 19a. Mean round weight-at-age (kg) of cod sampled during DFO bottom-trawl surveys in NAFO Subdivision 3Ps in winter-spring 1978-2005.

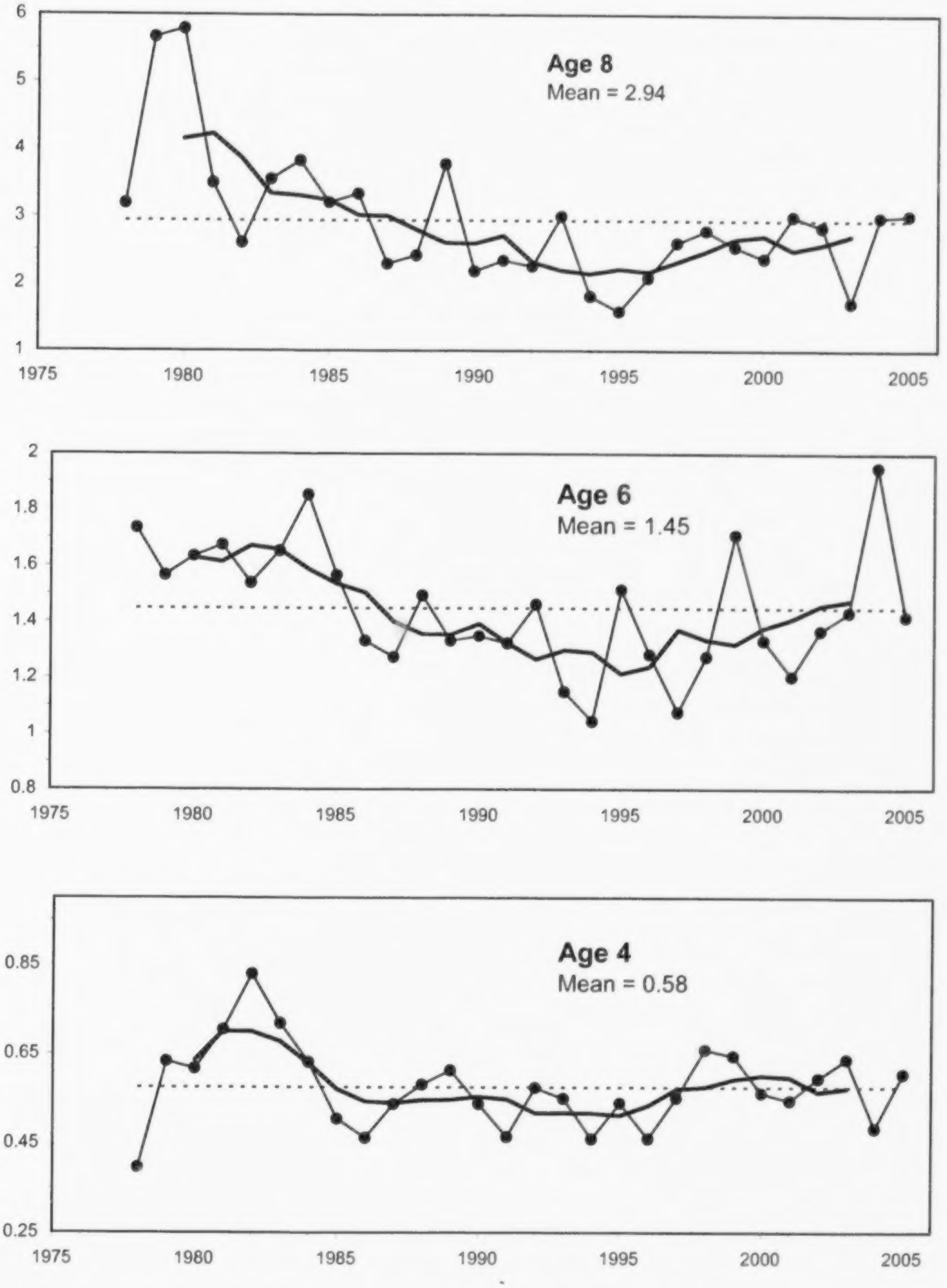


Fig. 19b. Mean weights (kg) at ages 4, 6 and 8 of cod in Subdivision 3Ps during 1972-2005, as determined from sampling during DFO bottom-trawl surveys in winter-spring. The lines in each panel indicate the annual means (solid line with symbols), a 5-year running mean (heavy solid line) and the mean for the period 1978-2005 (dashed line).

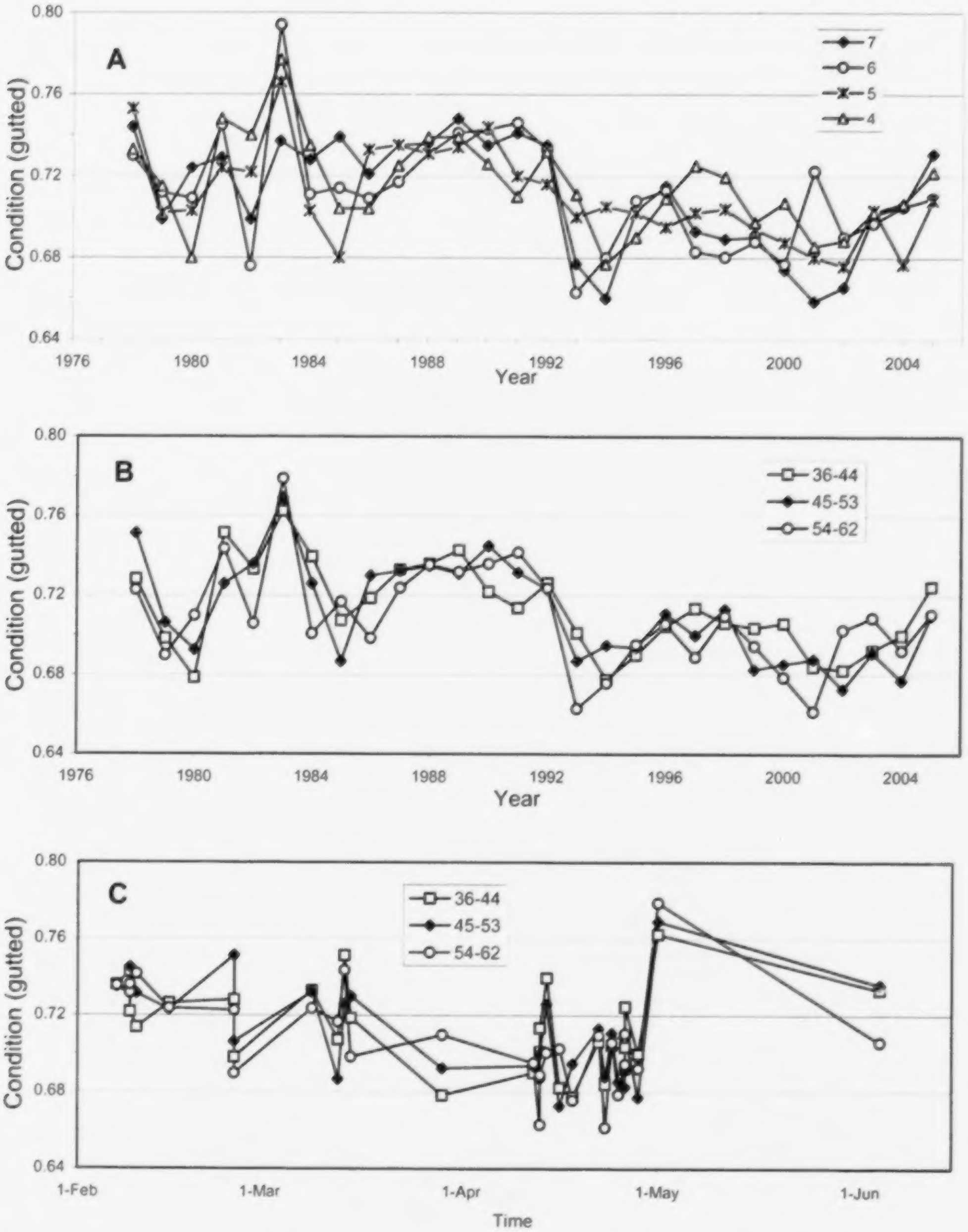


Fig. 20. Mean gutted condition of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in 1978-2005; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collection.

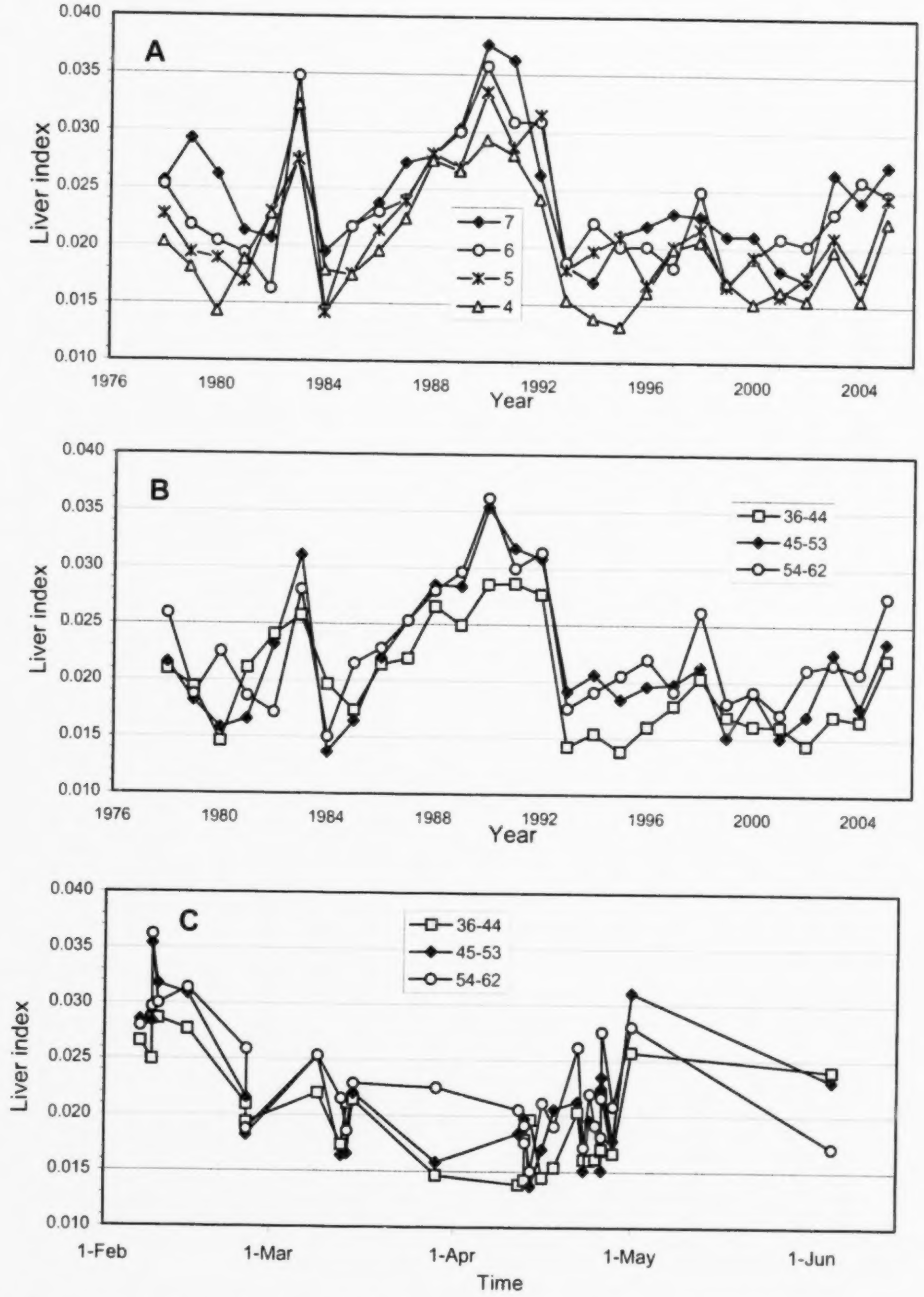
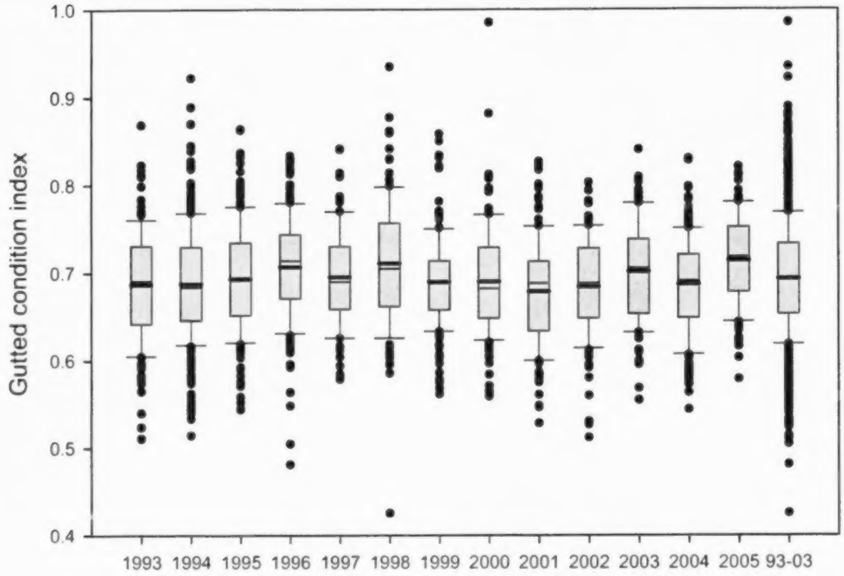


Fig. 21. Mean liver index of cod sampled during DFO bottom-trawl surveys in Subdivision 3Ps in 1978-2005; (A) by age and year, (B) by length-group and year, and (C) by length-group and median date of collection.



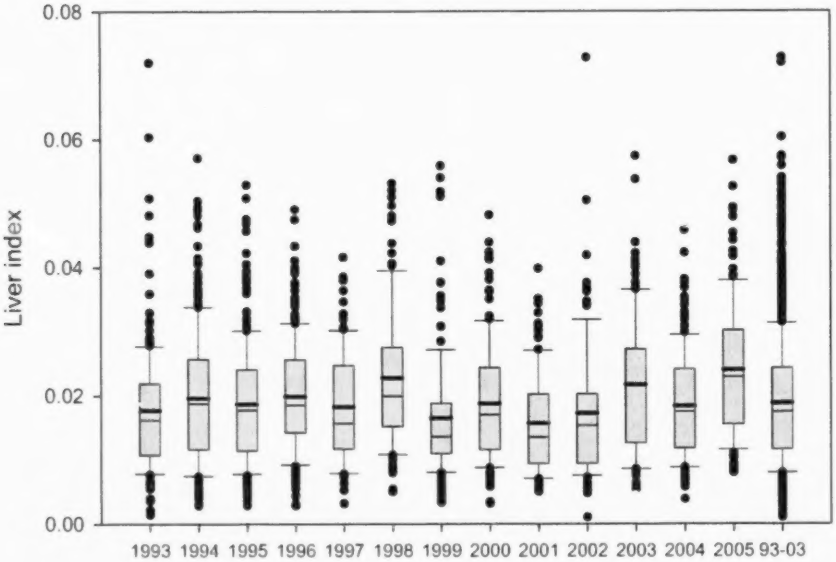


Fig. 22. Gutted condition (above) and liver index (below) of cod (40-59 cm only) caught during DFO research surveys during April-May in 1993-2005. The box furthest to the right in each panel represents all data from 1993 to 2003 combined. Each box plot illustrates the median (light line), mean (dark line), 25th and 75th percentiles (box), 10th and 90th percentiles (whisker caps) and all data beyond the 10th and 90th percentiles.

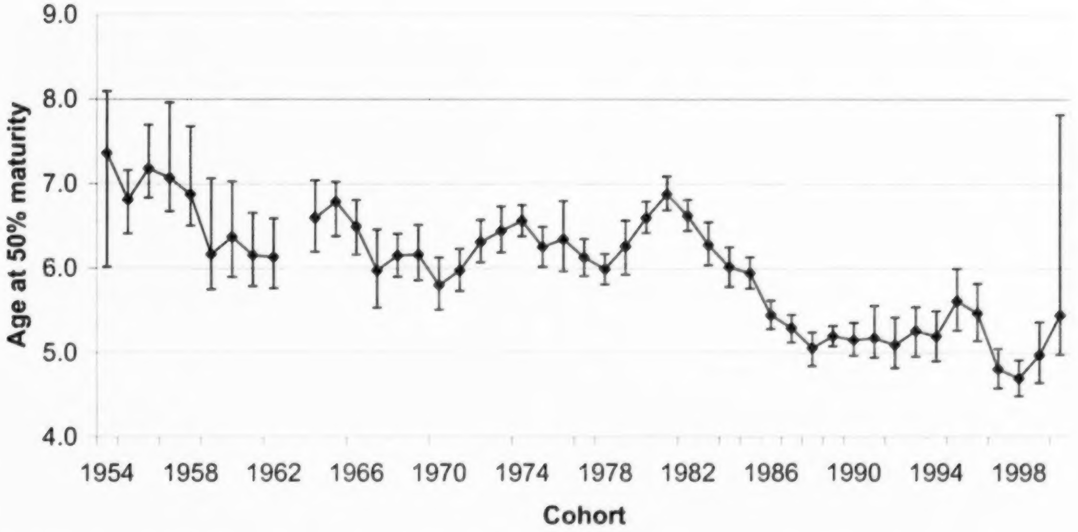


Fig. 23A. Age at 50% maturity by cohort (1954-2000, excluding 1963) for female cod sampled during DFO research vessel bottom-trawl surveys of NAFO Subdiv. 3Ps. Error bars are 95% fiducial limits.

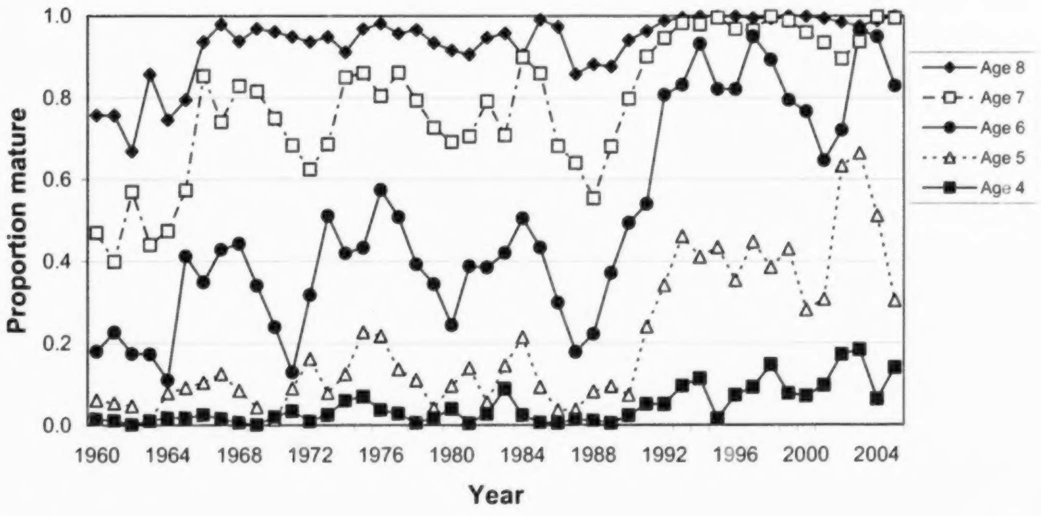


Fig. 23B. Estimated proportions mature at ages 4-8 for female cod sampled during DFO research vessel bottom-trawl surveys in NAFO Subdiv. 3Ps.

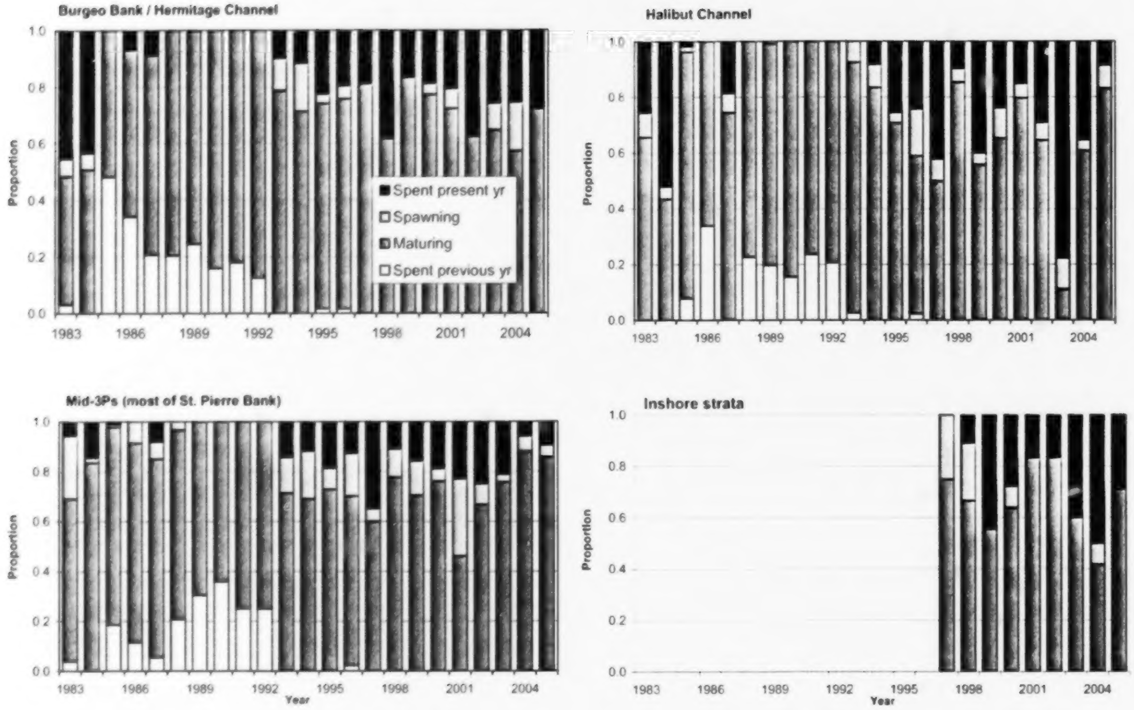


Fig. 24. Maturity stages of adult female cod sampled during DFO research vessel bottom-trawl surveys in four areas of 3Ps during winter/spring 1983-2005. There were two surveys in 1993 (Feb. and April); only the April one is shown here. Surveys were conducted mainly in April in 1983, 1984 and 1993-2005 and in February-March in the intervening years. Inshore strata have been sampled only since 1997.

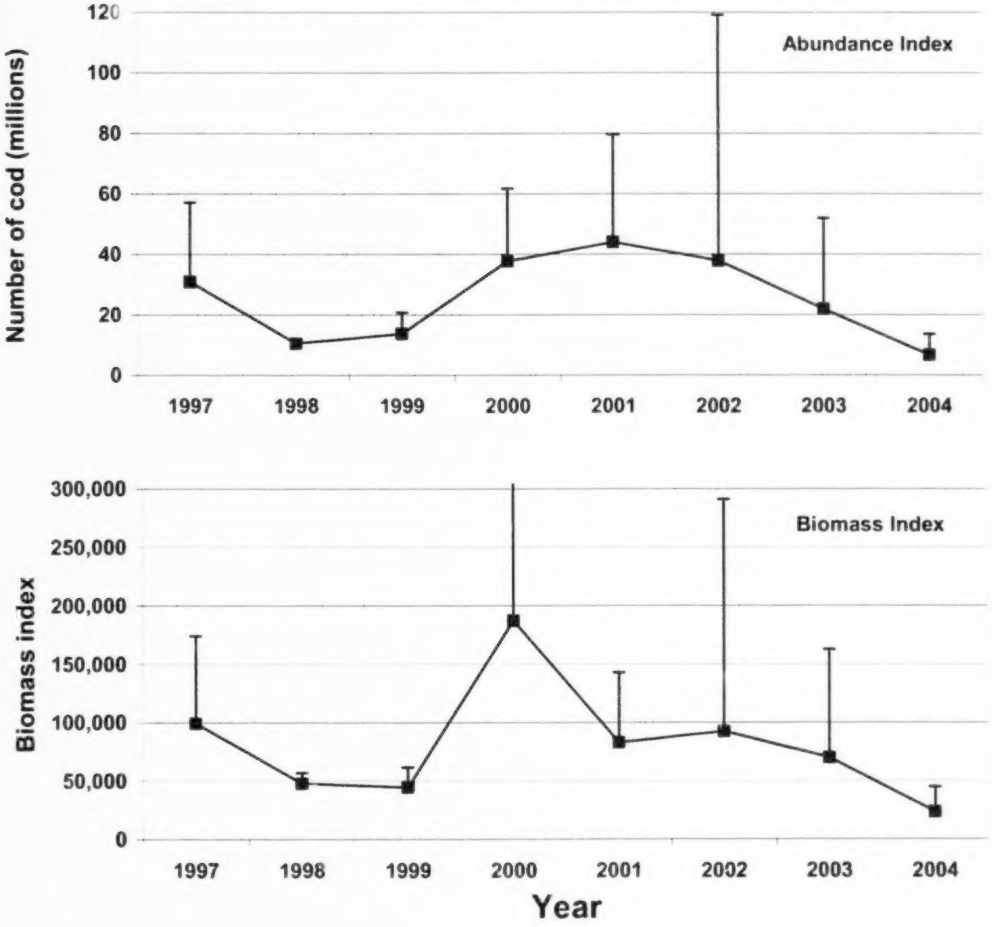


Fig. 25. Cod abundance and biomass indices (+ 1SD) for the fall industry (GEAC) bottom trawl survey of the offshore portion of NAFO Subdiv. 3Ps.

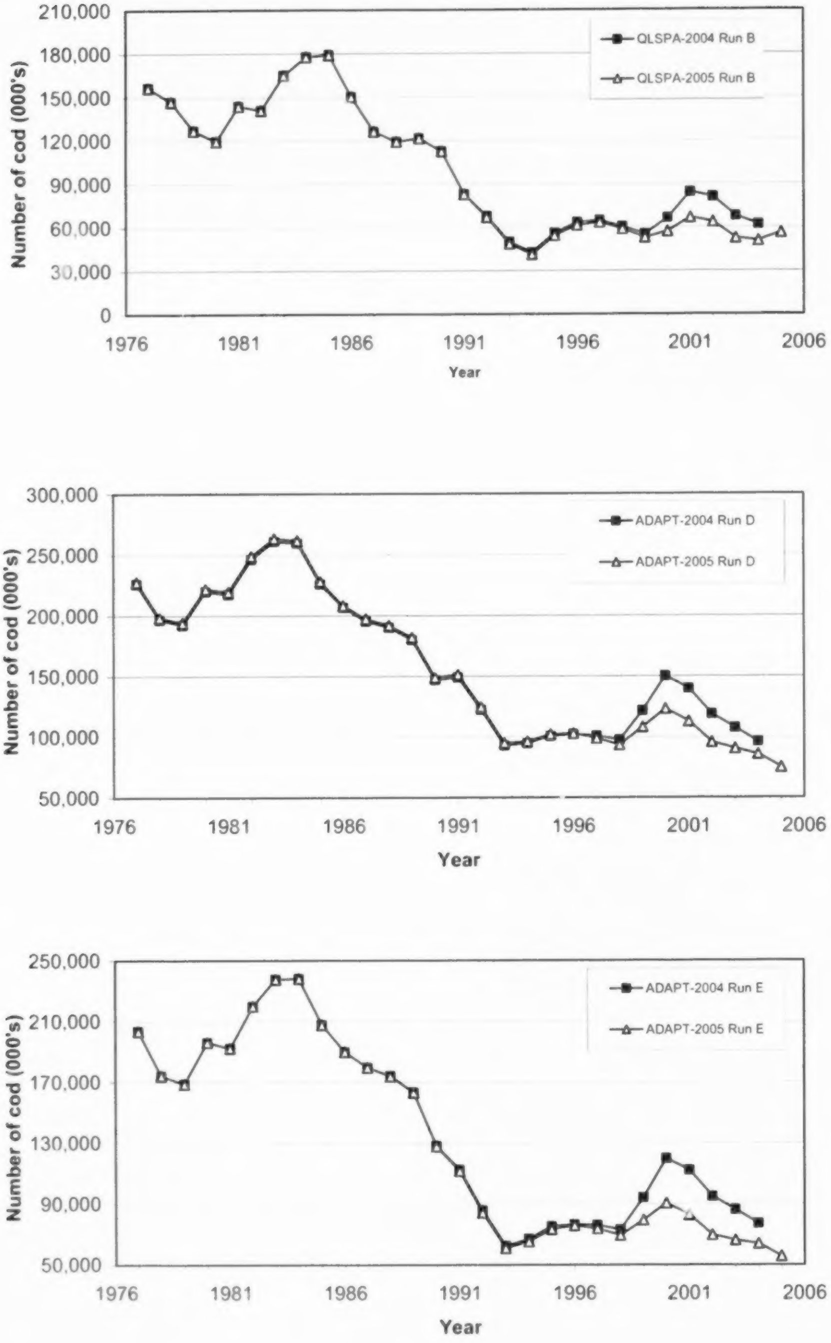


Fig. 26a. Comparison of trends in 3+ population numbers from three SPA formulations used during the 2004 assessment and updated with one more year of data during the 2005 assessment.

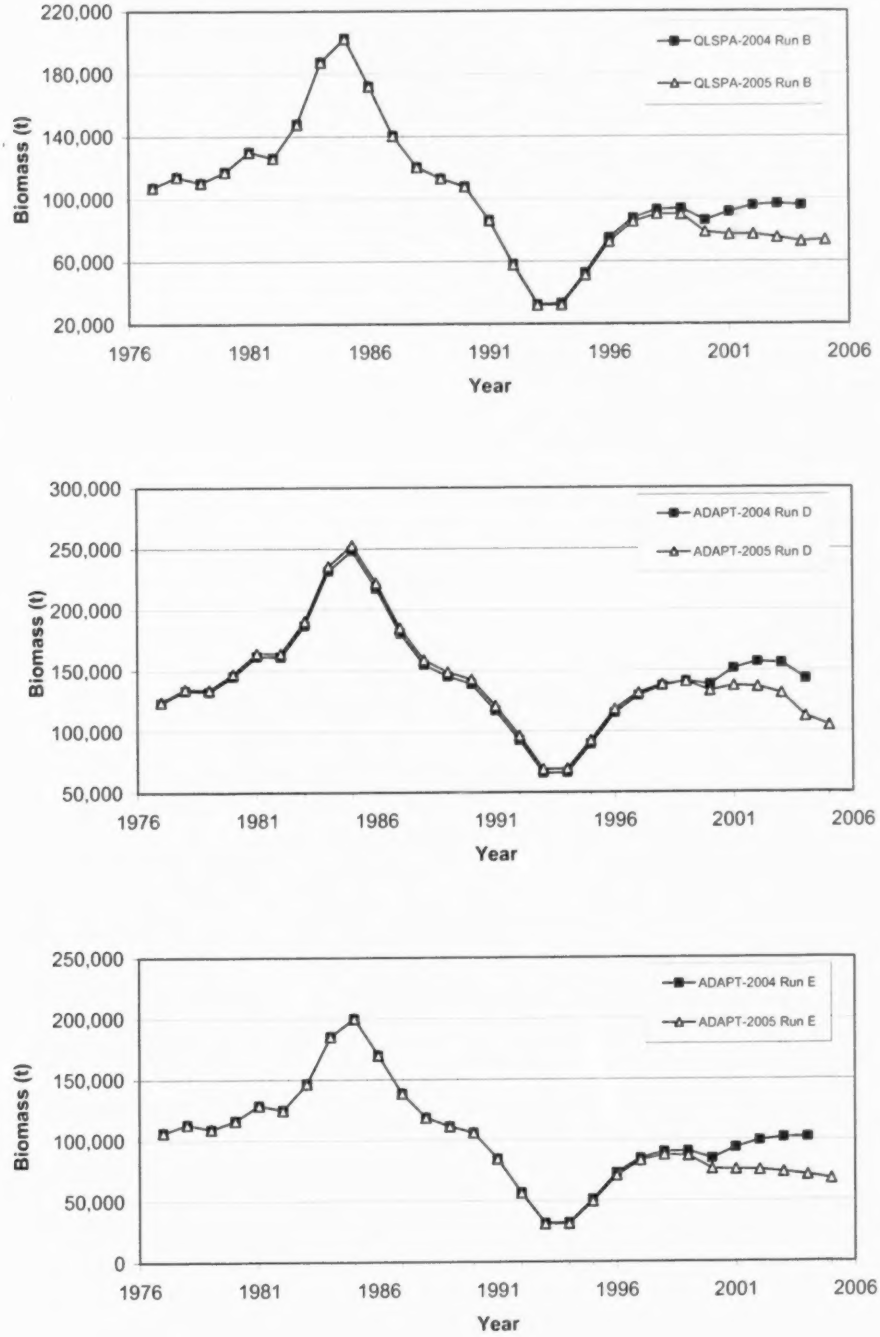


Fig. 26b. Comparison of trends in 3+ population biomass from three SPA formulations used during the 2004 assessment and updated with one more year of data during the 2005 assessment.

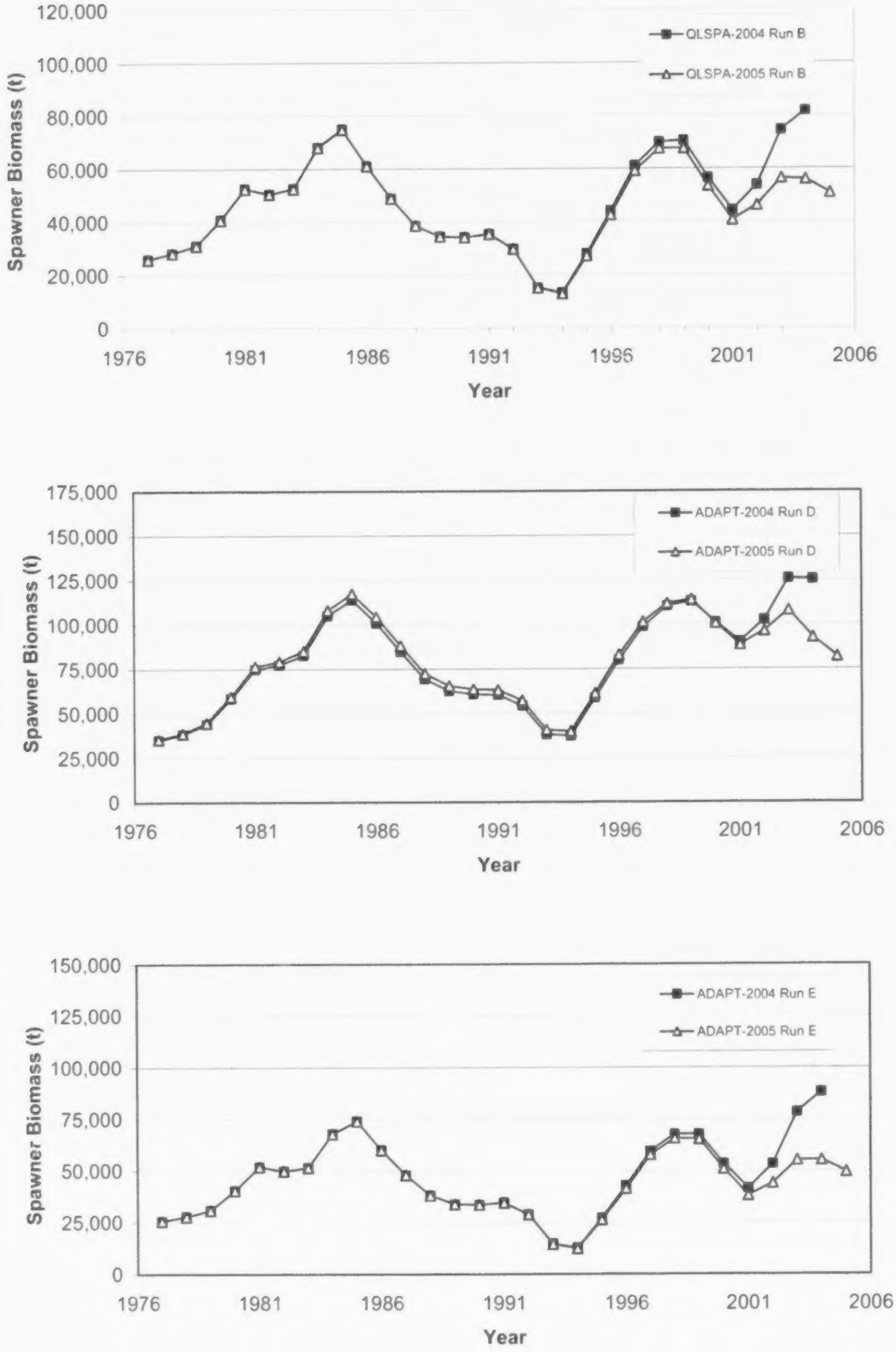


Fig. 26c. Comparison of trends in spawner biomass from three SPA formulations used during the 2004 assessment and updated with one more year of data during the 2005 assessment.

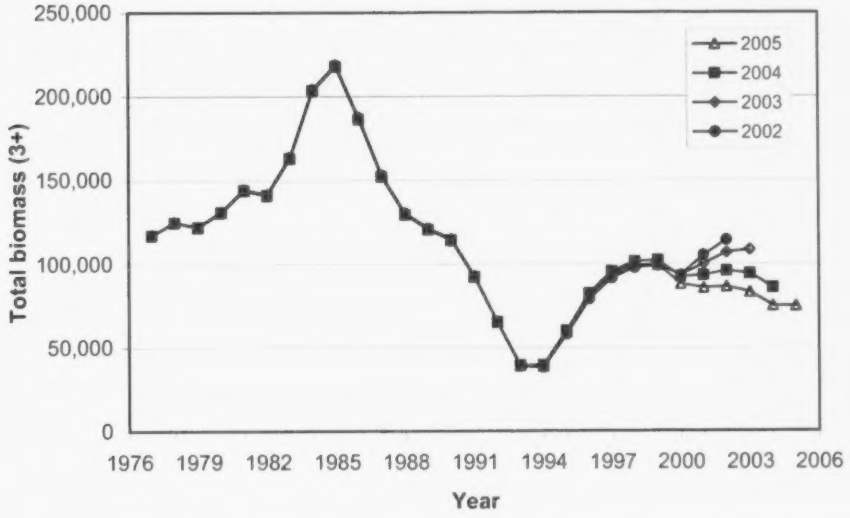


Fig. 27a. Comparison of trends in 3+ biomass from a retrospective analysis using using one SPA formulation (Run XSA-2005) at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

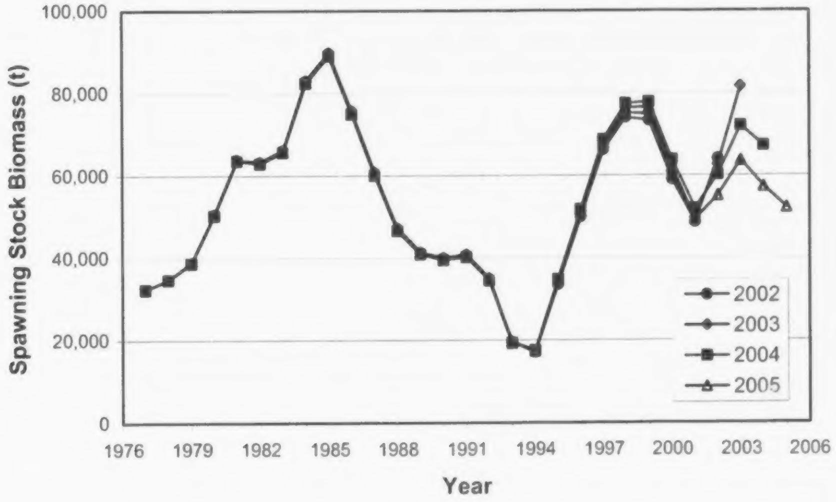


Fig. 27b. Comparison of trends in spawning stock biomass (SSB) from a retrospective analysis using one SPA formulation (Run XSA-2005) at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

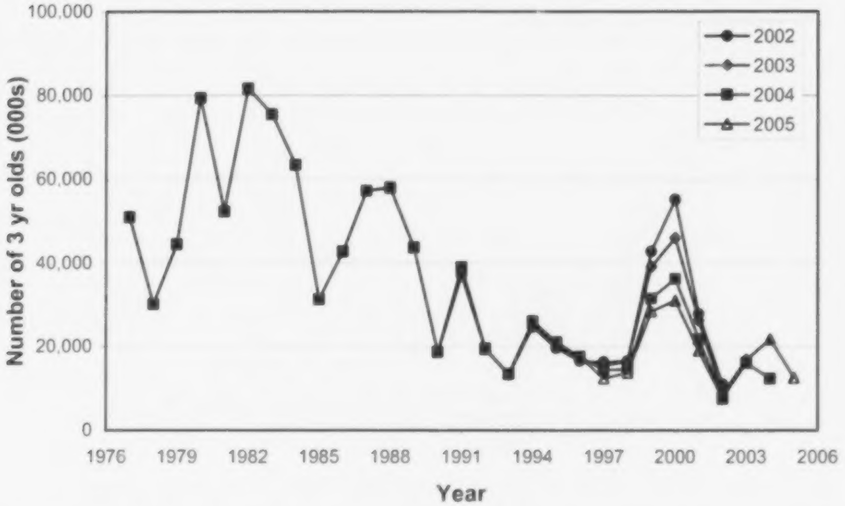


Fig. 27c. Comparison of trends in recruitment (nos. of 3 yr olds) from a retrospective analysis using one SPA formulation (Run XSA-2005) at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

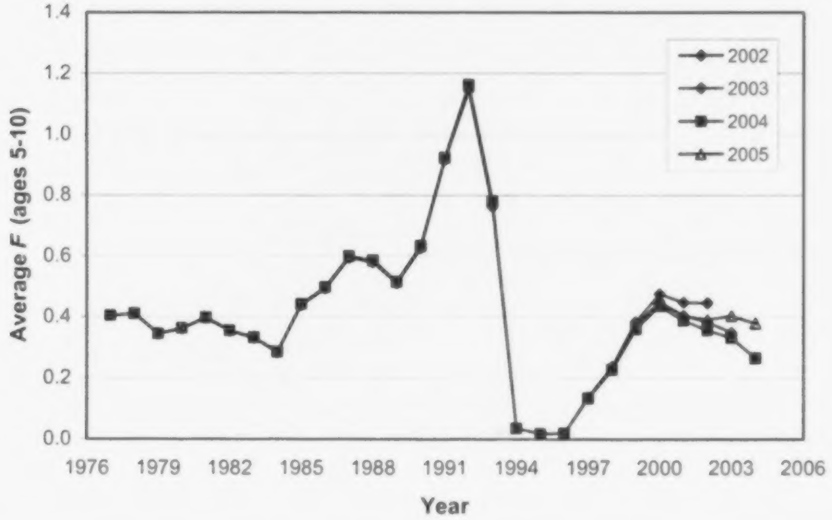


Fig. 27d. Comparison of trends in fishing mortality (average *F* ages 5-10) from a retrospective analysis using one SPA formulation (Run XSA-2005) at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

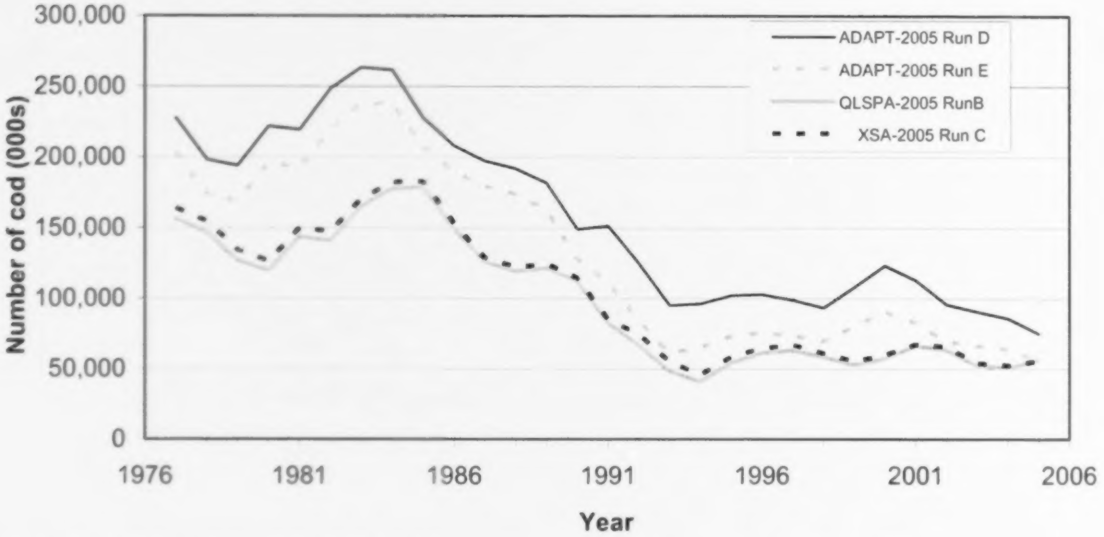


Fig. 28a. Comparison of trends in 3+ population numbers estimated from four SPA models/formulations at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

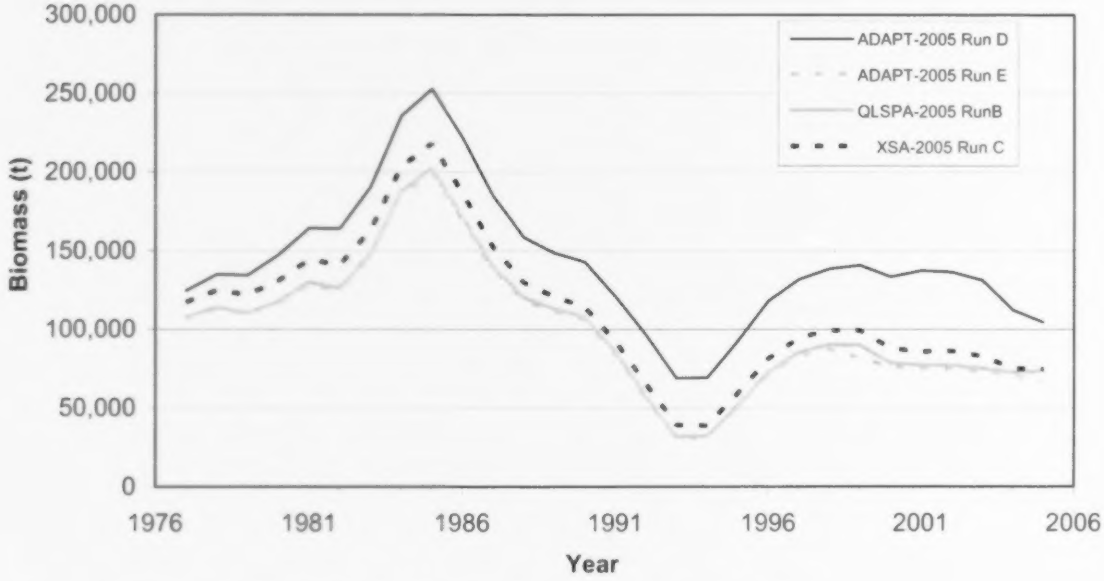


Fig. 28b. Comparison of trends in 3+ biomass (t) estimated from four SPA models/formulations at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

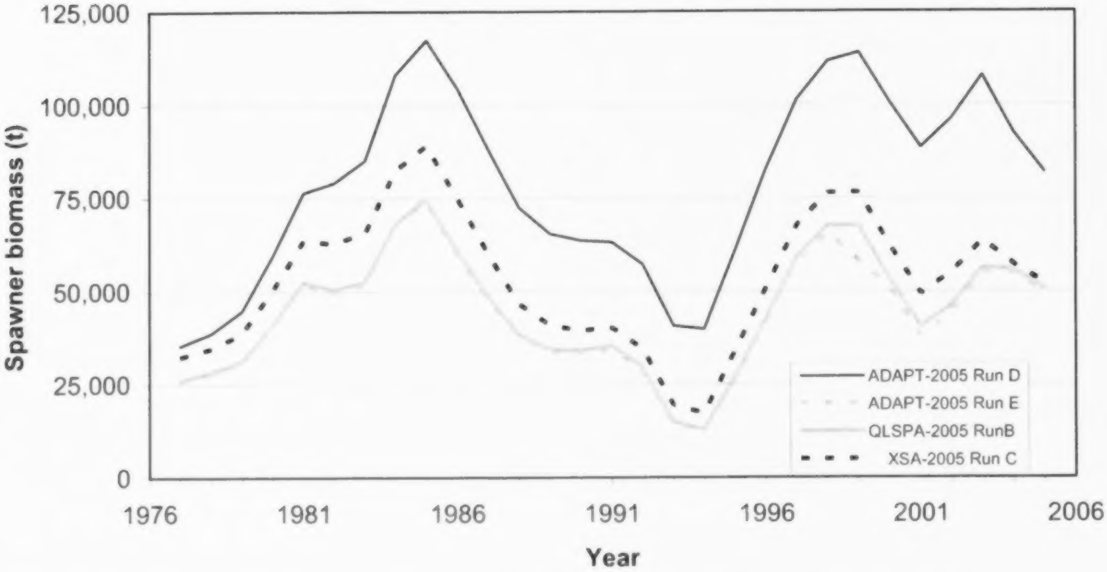


Fig. 28c. Comparison of trends in spawner biomass (t) estimated from four SPA models/formulations at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

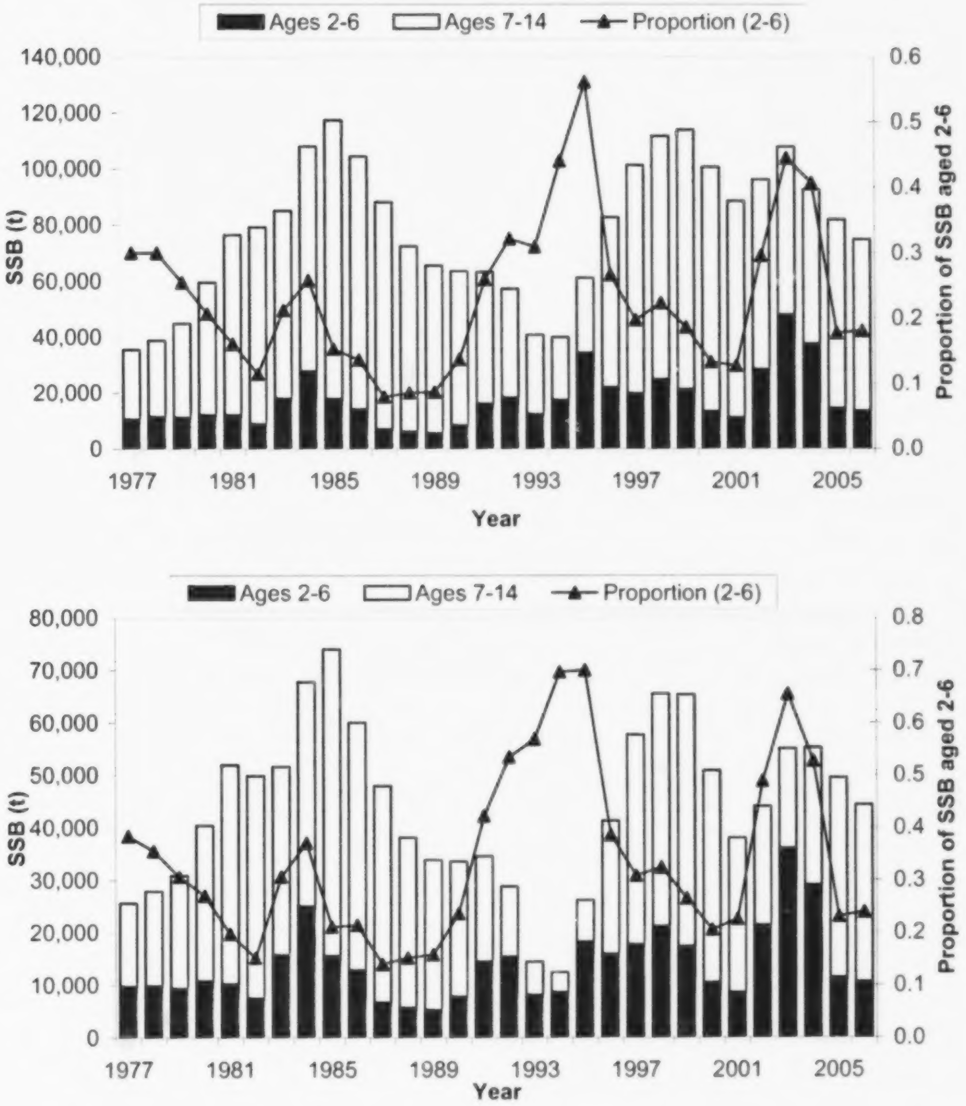


Fig. 28d. Trends in the age composition of the spawner biomass estimated from two SPA formulations at the October 2005 assessment of NAFO Subdiv. 3Ps cod. Upper panel ADAPT-2005 Run D, lower panel ADAPT-2005 Run E.

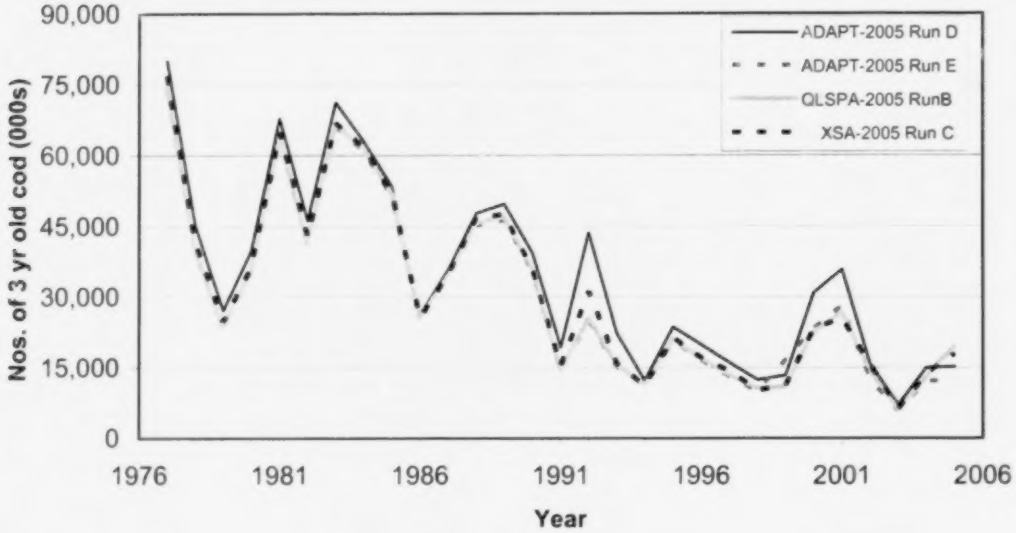


Fig. 28e. Comparison of trends in recruitment (nos. of 3 yr olds) from four SPA models/formulations at the October 2005 assessment of NAFO Subdiv. 3Ps cod.

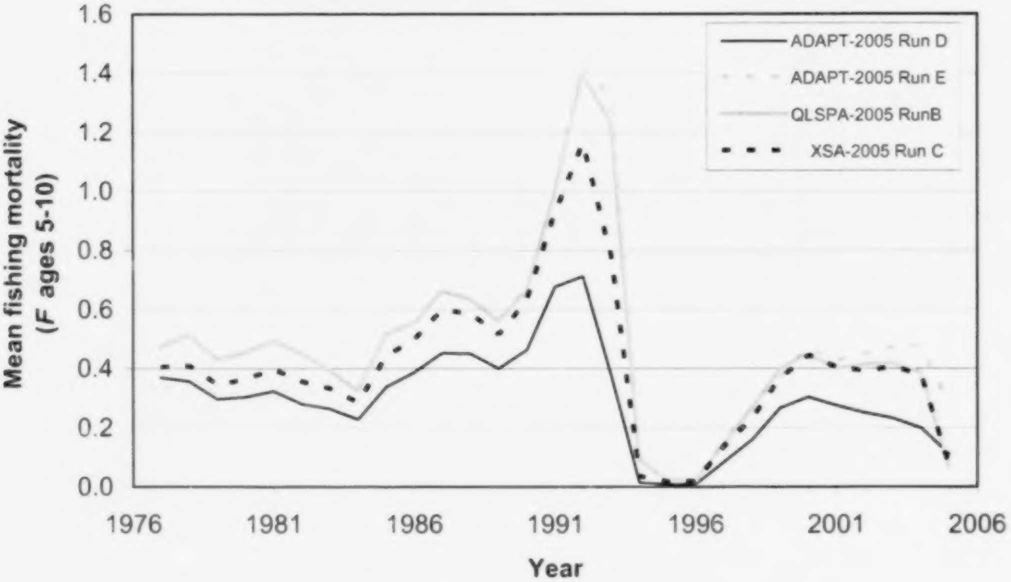


Fig. 28f. Comparison of trends in fishing mortality (average *F* ages 5-10) estimated from four SPA models/formulations at the October 2005 assessment of NAFO Subdiv. 3Ps cod.